September-October 1996

Issue 68

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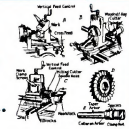
LATHE DESIGN

Construction and Operation



Lathe Design
Construction and Operation
by Oscar Perrigo
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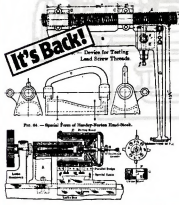
Design details of 1916 lathes and more...

We first reprinted this 1916 book over ten years ago, but discontinued it a few years back. We've now reissued it. It may be available for a year or two before we let it disappear again. With paper prices so high these days, these big books are becoming too expensive to print. I make you no promises how long we'll carry this.

Chapters include history of the lathe up to the introduction of screw threads; the development of the lathe since the introduction of screw threads; classification of lathes; lathe design: the bed and its supports; lathe design: the head-stock casting, the spindle and the spindle cone; lathe design: the spindle bearings, the back gears and the triple gear mechanism; lathe design: the tail-stock, the carriage, the apron, etc; lathe design: turning rests, supporting rests, shaft straighteners, etc; lathe attachments; rapid change gear mechanism: lathe tools, high-speed steel, speeds and feeds, power for cutting-tools, etc. testing a lathe; lathe work; engine lathes; heavy lathes; high-speed lathes; special lathes; regular turret lathes; special turret lathes; electrically driven lathes; and practical instructions on lathe operation.



Covering the almost 500 pages are three hundred and forty-one engravings illustrating everything from a modified parabolic lathe bed to a test piece for ascertaining if the head-stock spindle is parallel with the V's. You'll see engravings of various (but far from all) lathes such as the 20 inch swing turret head chucking lathe built by F. E. Reed Company.

This is a great book for lathe fanatics and machinery nuts (couldn't be YOU I'm referring to, could it?). Lots of pictures, lots of information on all kinds of lathes, and lots of ideas and useful info. It's a time machine and almost an encyclopedia. Expensive but useful and entertaining. Think carefully about getting a copy. Put it on your charge card. Get a second mortgage. Sell the ol' lady to the gypsies. I don't care. Just get a copy. You'll like it. (Oh, and be sure you tell the gypsies you're selling her as is...)

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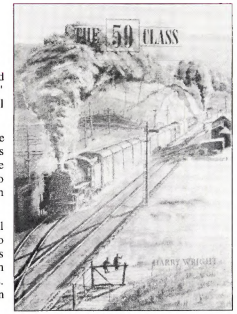
THE 59 CLASS



The NSWGR 59 class locomotives have always been popular with railway enthusiasts and model engineers. Next to the 38 class, it is the most popular prototype locomotive built in 5" gauge. Several fine models have also been built in 7 1/4" gauge. We expect this book will prove as popular as the prototype and the miniature versions built.

This book is written by Harry Wright (one of the authors of the popular 60 Class book). The text covers the background which led to the placing of the original order, USRA designs during WWII, loco shortages after WWII, prevailing loco designs, Lend Lease, and the Baldwin Locomotive Works, all of which played a part in the 59 class story. The author also relates his experience of working the 59 class along the NSW north coast line from Broadmeadow to South Brisbane in the days of steam.

The book follows the successful format used for the 60 class, with chapters on technical specifications, early test runs, subsequent modifications including conversion from oil to coal burning and problems the class encountered in their early days. The front cover features a specially commissioned painting from Robert Kingsford-Smith, a well known photographer and now artist. Inside are 66 full colour plates an 215 Black & White photos. There is also a fold out plan from Greg Edward's well known Data Sheets. Finally an appendix containing technical details and historical aspects of the class.

Following the progressive conversion of the 59s to coal fired, the class found a new niche working trains between Broadmeadow and Werris Creek and even beyond. The central obstacle on this route is the Liverpool Range which often necessitated bank-engines in both directions. The small station at Ardglen was near the summit and is the location depicted on the cover by Robert (Rags) Kingsford-Smith — a 59 working hard up the grade with the bank-engine pushing valiantly behind!

This hard cover book has 66 full-colour and 215 black & white photographs

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Contents

The Cover

Fresh from the paintshop, 42218 is seen here on an express run on the Galston Valley Railway in the fast fading light of late afternoon.

Photo: Brian Carter

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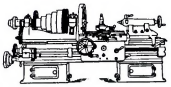

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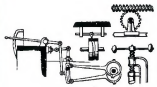

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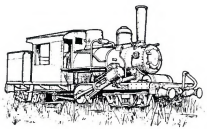

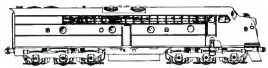

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Comment

For those who work — it's in the blood too!

For those of us with young families and work, time becomes limited and the stresses of life can get to you. I often come home tired and frustrated. The boss tells you to do this, and do that. Your wife has certain expectations which require fulfilling. The kids too have their needs. So a day can be quite a challenge. A challenge that is, unless you have a workshop to go to.

For me this is the best stress reliever of all. I mean, there is nothing better than belting something with a hammer — to let out all that tension — and at the end of it, something constructive has been made!

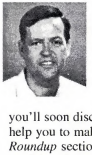
Yes I could sit in front of the TV all night. Yet this always makes me feel that something is missing in my life. Lets face it, there is something very rewarding about having an idea form in your head (usually after you have gone to bed, before you finally sleep), then to put it down on paper. Either as a sketch or a technical drawing, and then to create it. One minute you hold a piece of metal, the next its apart of your latest project. The idea has become three-dimensional, a tangible object that can be touched. When looked after correctly it will see your grandkids and maybe even their grand kids. I suppose you could call it your personal mark on the landscape, which will still be around long after you have gone.

This is no excuse for hiding away from family or responsibility. Everything in life must be in balance. The workshop however is my personal bit of space where no one can tell he what to do, or how long it should be done. It is a place where I unwind and can think clearly about important decisions in life that must be made.

The workshop is the land of opportunity, creativity and teaching. A place that gives purpose in life and a lot of enjoyment. For those of us who do not play sport, or live on computers, its a nice place to be.

Steve Reeves

This is an open invitation, during 1996, for all model engineers to tell us how you find "Model Engineering — an Enjoyable Hobby". I need one for our November issue... bmc.



To our new reader

If this is your first issue of Australian Model Engineering, welcome! We hope you'll look forward to the ideas, news and camaraderie in each bi-monthly issue.

One of the great things about our hobby is the way model engineers actively help each other. Unless you live in an isolated community, you'll soon discover who has valuable experience in your field of interest, or who will help you to make a part that's too big for your workshop machinery. Look in the *Club Roundup* section to find a club that's near to you; pay a visit and you'll usually find model engineers who live not too far away. Then you can experience the great fellowship that makes our hobby special.

This magazine is prepared in the same spirit of "model engineers helping each other". About two dozen people put many hundreds of hours work into each issue — all on a voluntary basis — to help model engineers in Australia and New Zealand keep up to date and stay in touch.

We rely on our readers to write articles for us — for the same (non-existent) rate of pay! If you have ideas or techniques that you feel would be interesting to others, please drop us a line. We'll gladly help with preparation of artwork or editing if that's necessary. Most important of all, please support the people who advertise in our magazine. Without them to pay the bills, you wouldn't be reading this!

Brian Carter

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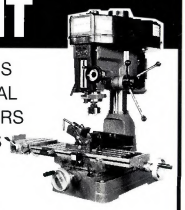

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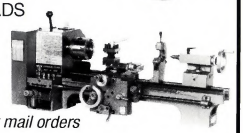

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The Building of *Little Yarra*

by F.R. Farhall

Photos by the author unless otherwise noted

After having built a 7¼" gauge *Marie Estelle* steam locomotive, basically to the design of Don Young but with some modifications of my own, and then having operated it at the Box Hill Miniature Steam Railway in Melbourne for several years, I felt that I would like to build a second locomotive. I reasoned that the experience I had gained should make the new locomotive easier to build and, hopefully, a better engine. I also felt that I would like to chose a locomotive that was a Victorian or Australian prototype which was not currently being modelled.

Baldwin Locomotive Works builders photo of ***Little Yarra****.*
Photo by courtesy of the Light Railway Research Society.

Research

For some time I had known of a private railway, about 50 km east of Melbourne and known as the Powelltown Tramway, that had operated from 1912 until about 1946. This 3ft gauge railway operated a stable of six locomotives consisting of two Shays, an 0-4-0 side tank from Kerr Stewart and Co, an 0-4-2 saddle tank from Andrew Barklay and Sons, an 0-6-0 tender engine from W&G Bagnall Ltd, and a beautiful little 2-4-0 tender engine from Baldwin of USA. This, I decided, would be the prototype for my model but, unfortunately, the engine was scrapped somewhere about 1946-47.

The next task was to obtain specifications and drawings, and as much relevant information as possible. As time wore on it became apparent that there was very little information available. A few photographs existed in some of the Light Railway Research Society publications but that was all. I wrote to the Baldwin Archives in the USA, only to discover that all they had was the original order from the Powell Timber Co (the owners of the Tramway), Baldwin's own Class No record - 6-14C -, and the information that engine No 8 of this class was delivered in June 1912. No drawings remained.

The prototype

The best data I could find was in the LRRS publication *Powelltown* which included the builder's photograph. This was a very clear, almost broadside-on shot, The accompanying article gave a short specification, including some dimensions and a general description which read as follows:

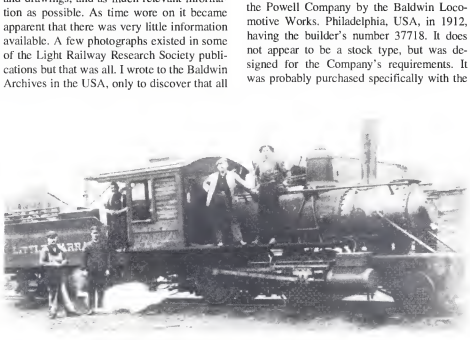
"*Little Yarra* was the first Locomotive obtained by the Victorian Powell Wood Process Ltd. It was a 2-4-0 tender loco built to order of the Powell Company by the Baldwin Locomotive Works. Philadelphia, USA, in 1912, having the builder's number 37718. It does not appear to be a stock type, but was designed for the Company's requirements. It was probably purchased specifically with the passenger service in mind, and was used as the regular train engine.

As originally delivered, *Little Yarra* was painted red, with white lining and black trim. The name *Little Yarra* was painted in white letters on the tender sides. It also had a wooden cowcatcher, kerosene headlamp, and a polished brass bell. The tender was fitted with a fixed leading axle and a trailing bogie, which facilitated tender-first running. Outside D valves were driven from rocker arms from inside Stephenson valve gear mounted on the leading driving axle. The dome carried a safety valve and a shrill whistle. The spacious cab was provided with padded seats and the pull-out throttle and Johnson-bar reverse were located on the right hand side. A steam brake operated on the driving wheels and a hand brake on the tender wheels.

In its original condition, *Little Yarra* presented a very handsome, even racy appearance, but in later years, when it was not so well looked after, it showed many signs of its hard working life. It had lost its cowcatcher and brass bell, and the kerosene light was replaced with an acetylene gas light, and later a battery powered car headlight. The acetylene light provided very good light in the forest sections. The lined red livery was replaced with unlined green, the name being obliterated at the same time. In 1941, it was reported as being recently overhauled and repaired, and was freshly painted in dull green, with polished fittings.

Although mainly used between Powelltown and Yarra Junction, *Little Yarra* also ventured out to Powelltown bush.

At the auction of equipment in 1945, *Little Yarra* was sold to Cameron and Sutherland, the machinery merchants, who bought it for the British Phosphate Commission for use in Nauru. There is no record of *Little Yarra* ever being shipped to Nauru, and it seems likely



Little Yarra prior to overhaul and repainting green, circa 1930.
Photo by courtesy of the Light Railway Research Society.

that it was judged to be too worn to be worth repairing and was probably scrapped in Australia."

From the above it became obvious that if the model was to proceed, I would have to prepare my drawings from the limited information available.

The decision

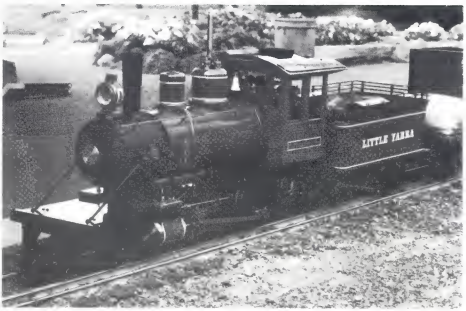
Having decided on the prototype, I then had to decide on the gauge and scale for the model. The Box Hill Miniature Steam Railway track is dual gauge of 5" and 7¼". The final decision was made for me by the size of my workshop and its rather old equipment. This engine, in 7¼" gauge and scaled at 2½" per ft would be about 9ft long and 2ft 3ins high, far too large for me to handle.

Therefore decided to build *Little Yarra* in 5" gauge at 1.075ins per ft scale, making the overall dimensions 6ft long by 11½" wide and 20" high to the top of the chimney. To arrive at these dimensions I had scaled off the Baldwin builder's photograph as best I could. Comparing these measurements with the information in the Powelltown publication, the diameter of the driving wheel was 3ft 6ins. The wheel centres were 8ft 6ins and the diameter of the tender wheel was 1ft 10ins. I was able to estimate that the original locomotive had an overall length of 40ft, a height of 11ft and a width of 6ft 9ins. These dimensions formed the basis of my scaling.

Drawings and design

My next step was to make some general arrangement drawings, including as much detail as possible from the photographs. This gave me a better idea of how the finished locomotive would look. At this stage, I decided that a Briggs steel boiler would be used in the model, rather than a copper boiler. The reason for this decision was that I had no detail of the original boiler, so there was no way a scale model of it could be built, and the extra weight of a steel boiler would be an advantage.

Having built the 7¼" gauge *Marie Estelle*, I realised that the inside Stephenson valve gear on that model, with the eccentrics on the front driving axle working backwards



Waiting for passengers at Box Hill station.

to rocker arms mounted on the top member of the frames and then forwards to the outside D slide valves on top of the cylinders, was the same as on the *Little Yarra* This solved the cylinder/valve gear problem, as the same arrangement, including the *Marie Estelle* cylinder castings could be used. In order to increase the power output slightly, the bore was increased from 1⅝" to 1¾", with the stroke remaining at 2½". The sloping cylinders of the *Marie Estelle* would be re-arranged to the horizontal position and modified to represent the Baldwin practice. Suitable driving and pony wheel castings were also available.

Working sketches were prepared for the frames and sundry parts, incorporating the *Marie Estelle* cylinders and valve gear design. Drawings for other parts of both the engine and tender were produced as and when required.

Construction

The first manufacture was on the frames. They were made of ½" square BMS with the risers and stretches etc. fitting into milled slots in the main members. All joints not required to come apart for maintenance were secured with 3/16" UNF cap screws and held with 601 Loctite®. The bottom frame members were made removable so that axles and wheels could be dropped. All wheels were sprung with two ½" diameter coil springs above each axle box. Bronze axlebox bearings were fitted to the ⅞" diameter driving axles.

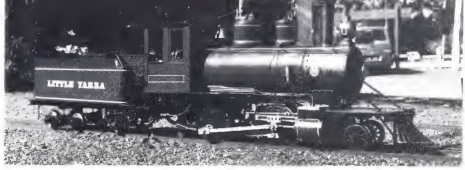
Work proceeded on the motion and other mechanical parts. The connecting and coupling rods, together with the crossheads and all valve parts were made from mild steel with bronze bushes to resemble, as near as possible, the prototype depicted in the various photographs. The double slide bar assembly was made from ½" x ¼" BMS with a bronze slipper working in between the slide bars, as was common Baldwin practice at the time. Polished copper cylinder and valve chest covers were fitted and the cylinders were lagged and cladded.

The pony truck was fabricated from mild steel and was sprung from the front deck. Side control springs were also fitted.

I decided that the best way to model the original wooden cowcatcher was to build it up from ½"ins by ⅜"ins mild steel sections, silver soldered together. The result was passable.

Between the frames and just forward of the rear driving axle, an axle pump of ⅝" bore and ¾" stroke was mounted. This pump was driven from an extra eccentric on the front driving axle. The feed water was passed through a clack valve assembly mounted on the same stretcher as the front pony pivot, and then to a feed water heater consisting of 3½ turns of 5/16" copper pipe wound inside the smoke box. The water was then fed directly into the front tube plate of the boiler.

The steam brake cylinder was fitted to the same mounts as the pump and operates on the rear driving wheels only. The smoke box sad-

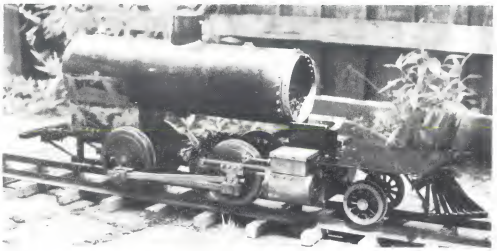


Little Yarra on the ready-track at the Box Hill Railway.

dle was made from a piece of 3½" square tube and bolted to the frames with 12 by 3/16" UNF cap screws, thus forming a rigid stretcher for the frames.

Boiler

Attention was then given to the boiler. The only suitable seamless tube for the shell was 5/16" wall thickness and 6⅝" outside diameter. Unfortunately, this was slightly overscale but had to do. The total length of the boiler was made 22" from the back head to the front tube sheet. The fire box was made 7" long inside, with the grate 2¾" wide by 6¼" long. Refactory lining was applied to the four sides of the fire box. A ½" outside diameter copper syphon was fitted in the firebox and a fusible plug was installed in the centre of the crown sheet. The tube plate, crown stays and crown sheet were made from ½" boiler plate and fully welded. The inner dome was made from a 2" BSP steam socket. Fifteen ⅝" outside diameter copper tubes were expanded into place. All fittings etc. were made to comply with the AMBSC code part 2, 1987.



The Briggs steel boiler sitting on the frames.

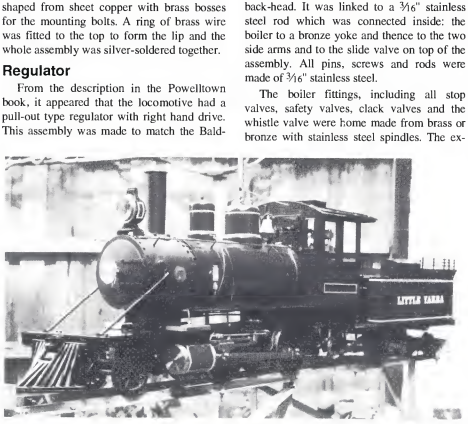
Chimney

The next job to be tackled was the chimney. A casting was available for a tapered Baldwin chimney but unfortunately it was too short for this engine. I made my own from a piece of 2" copper tubing, 6½" long. A thin wedge was cut from the length of the tube, starting at the bottom and finishing ¼"ins from the top, and the slot was closed together to form the taper. The flange at the base was shaped from sheet copper with brass bosses for the mounting bolts. A ring of brass wire was fitted to the top to form the lip and the whole assembly was silver-soldered together.

Regulator

From the description in the Powelltown book, it appeared that the locomotive had a pull-out type regulator with right hand drive. This assembly was made to match the Baldwin practice as near as possible, by checking the various photographs and the NA engines of *Puffing Billy* at Belgrave. As I have had problems with priming on my *Marie Estelle*, I decided to make a horizontal slide valve regulator with the steam inlet as near as possible to the top of the dome, rather than the vertical valve arrangement of the *Marie Estelle* which would have placed the valve some 2½" closer to the water level. The regulator valve body was constructed from two pieces of 1¼" square bronze silver-soldered together to form an elbow, with the slide valve and steam inlet at the top, and the ½" internal steam pipe to the cylinders screwed into the horizontal outlet facing the front. The cab regulator handle was mounted on the back-head. It was linked to a 3/16" stainless steel rod which was connected inside the boiler to a bronze yoke and thence to the two side arms and to the slide valve on top of the assembly. All pins, screws and rods were made of 3/16" stainless steel.

The boiler fittings, including all stop valves, safety valves, clack valves and the whistle valve were home made from brass or bronze with stainless steel spindles. The exceptions were the water gauge and pressure gauge, which were purchased items. A Baldwin type turret was fitted, consisting of a central riser on top of the boiler and angle type stop valves. A circular firedoor was fitted, complete with a Baldwin type two-position handle and catch.



A closer view of the completed locomotive.

Lubrication

As the original *Little Yarra* would almost certainly have had a hydrostatic cylinder lubricator, a suitable lubricator was made, similar to the Don Young design for *Lucky Seven*, but with two modifications of my own. The needle valve spindles were provided with packing glands and the oil nozzles were extended approximately ¼" within the sight glasses. The unit was mounted on the left-hand side of the boiler, inside the cab, with the oil reservoir beneath the footplate.

Just forward of the oil reservoir, a Sandberg 1¾" pint injector was mounted to feed through a clack valve on the left-hand side of the boiler, near the smoke box. The water supply to the injector was supplied through a 5/16" copper pipe from the tender, and was controlled by a plug cock operated from the footplate. An aluminium casting was obtained for the steam dome, but the sand dome was made of pieces from the scrap box, as no casting was available. The boiler was lagged with felt and cladded with 26g galvanised mild steel and painted bright gloss red. The smoke box and door were painted Pot-Belly black.

Cab

I was unsure of the best way to go about building the cab. On the prototype, the cab was all wood, as was the case with a lot of the Baldwin engines of the period, but it seemed to me that some metal in the construction would make it more robust. In the end, a compromise was struck with the vertical sheets being cut from ¼" plywood and the roof from 16g mild steel. The window cut-outs were fitted with thin wooden inserts to resemble sashes and sills, and painted white. The cab was painted red with a black roof. I am

pleased to say the result closely resembles the prototype photographs. On the inside of the cab, I used aluminium angles to join the front and sides to add to the strength of the joints.

Tender

The next job to tackle was the tender and for that I had no dimensions except for the wheel diameter. The few photographs available to me were the only information from which to work. I prepared a sketch, of sorts, detailing the unusual arrangement of a fixed leading axle and a trailing bogie. Separate sketches were made of the bogie and the front axle box assembly. The bogie was made from material I had on hand and had mild steel disc wheels. Coiled springs were fitted behind the dummy leaf springs to simplify construction. The frame was fabricated from ¾" mild steel angle and channel sections, and the tank and fuel bunker folded from 16g galvanised mild steel, spot welded and riveted together and sealed. A ¾" bore hand pump was fitted and was made accessible through the filler hole. A screw-down hand brake was mounted on the tender foot plate and was made to operate on the front leading wheels. The bogie was not braked. Two large tool boxes were fitted to the top plate of the tender, on either side of the fuel space. The original *Little Yarra* would have been wood fired and, as such, removable planks would have been fitted to the front of the fuel space to enable access to the wood fuel. Since the model would be fired with char at Box Hill and this facility would not be required, dummy planks were fitted to the model.

The tender was painted the same bright red as the rest of the engine. All the frames and parts below footplate level were painted in gloss black. The name *Little Yarra* was painted in white letters on each side of the tender and both the tender and engine were lined with white, as was the prototype when new.

Conclusion

My model has now been operating for about nine months and has proved to be a good steamer. It has more weight than my *Marie Estelle* and, with all wheels sprung, it has better track adhesion and less of a slipping problem. There were a few teething problems, such as locking screws not properly tightened, but nothing major. These have now been eliminated and the engine performs quite well.

This was not a fine-scale model and some detail, such as rivet heads etc were left out. Also, there were a few things I would have tackled differently if starting again. In addition, I had to keep in mind during construction that this was to be a working model capable of hauling passengers and so all working parts were made to conform to standard live steam model engineering practice. However, the general impression is, I believe, a reasonable representation of the original.

Garratt Gossip

with John Cummings

Since the last Garratt Gossip I have received a letter from a NSW modeller who is building a 5" gauge Darjeeling Garratt. He tells me that he is also building a 5" gauge railway on his property that will resemble the Darjeeling railway! It is even on the side of a hill!

Mel Skinner of Victoria arrived at the Illawarra Live Steamers Hot Pot run with his partly built NSWGR AD60 class Garratt. Mel assembled "the beast" on a turntable road so that everyone could get a good look at it.

It was interesting to hear the various comments of those who saw it. Comments like "Bloody big thing!"... "The workmanship is terrific!"... "How is he going to fire it on the run?"...

The latter was an interesting question — in March 1995 I had the pleasure of driving Bob Brown's freelance Garratt at the Adelaide Miniature Railway Society's track. Bob's Garratt was capable of completing three circuits of the track on one firing. It was a strange sensation to drive this loco because the driver rides on a wagon behind the loco — it took some getting used too.

I have been getting many enquiries asking "How's the K progressing?" I am pleased to report that the low pressure engine (front unit) is just about complete. I recently fitted the reversing gear and wonder of wonders it works! It was a great feeling. I must admit that I was somewhat apprehensive because I followed the original drawings and there were so many levers, shafts and pins that I thought the miniature components would flex and buckle under the strain. Now that my spirits have lifted I'll get on to the assembly of the high pressure (rear unit) valve gear.

Don't forget to keep in touch with your Garratt news — I need something to gossip about! That's why there is a big gap between GGs.

Please send your Garratt gossip to me care of the AME postal address on page 3.

Two views of Mel Skinner's 60 class at the ILS Hot Pot run.
Both photos: Brian Carter

Sawing Glass with a Diamond Saw

by Peter Dawes

Cutting glass tubing by nicking and breaking often results in an irregular end with a sharp sliver on one piece and a corresponding wedge out of the side of the other piece. In contrast, sawing glass with a diamond saw is quick, easy and foolproof — with just a couple of provisos.

The saw blade for glass cutting is a very thin disc (about 0.8mm) of bronze impregnated with diamond grit on the outer 12mm or so of the rim. It is quite different from the heavy segmented industrial blades. It can be 75 to 150mm in diameter.

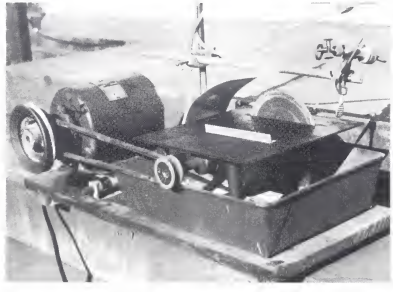
My sawbench is made like a miniature wood circular-saw bench. The blade projects up a fixed distance through a narrow slot in the table, which can be about 100 to 150mm square. My table top is steel, so I have to dry it off after use. It could be a piece of 12G sheet brass, for example. The table is simply supported by four legs off the base of the tool. The saw arbor should have a ball-race with a small pulley to drive it — at about 3000 to 4000 revs/min depending on the diameter of the blade. A small motor of about ⅛ hp to ⅙ hp is enough to drive it. I don't know the officially recommended surface speed in feet per minute for diamond saws but those speeds work well. More important is that the saw is held between relatively wide flanges — the same as a wood saw blade, but wobble-free. Only a few thou of wobble is tolerated: the less the better. The main mechanical requirement is rigidity and the ability to operate smoothly at these speeds with water spraying around. Otherwise the requirements are very much the same as those for a precision grinding setup like the Quorn tool and cutter grinder.

The most important additional part of the saw is a system to supply a constant, small, steady, stream of water to the cutting edge — and I mean *constant*. Even a break in the stream of a few seconds can damage the saw and perhaps the job. So it requires a bottle (say a five litres) of water above the saw with gravity feed via a piece of plastic tube, and a nozzle directed at the edge of the blade. A pinch-cock or other means of controlling the flow is required. The hardest part is making a suitable fixture to hold the nozzle in position. Laboratory retort stand clamps make a good knock-up support. Copper tube with a 1.6mm diameter nozzle and a model loco valve would be good.

The arbor must be able to run in a watery environment and the whole sawbench, less the motor, should sit in an aluminium cake tray about 300mm square with deep sides — say about 100 mm deep. There should be a splash shield at the back and part way over the top of the blade, as a steady mist of water is thrown off in the plane of the wheel. Waste water drains out of the tray via a hole and tube to a bucket below.

That's all you need to get started on sawing, but a brass fence and brass cut-off stops can be added as the need arises.

One job the saw will do is cutting off hard glass (borosilicate or pyrex) tubing for water gauge glasses. Edges can be smoothed or bevelled (arrised) by just rotating the job *lightly* against the side of the wheel. Also, if you want to cut a small rectangle of glass to make a safety glass shield for a water gauge or a sight glass for an oil tank, it's as easy as sawing a piece of wood — though a bit slower.



What you cannot do is curve the cut by twisting the work against the blade, which is much too thin for that. All cuts must therefore be in straight lines. You can always cut a corner off in a separate cut to form a rounded edge if needed. You could cut a notch in a piece, or a corner off a loco window pane (a cab side window for example) with no trouble at all, but the saw is not suitable for removing less than a saw-blade width. That job has to be done by hand grinding on a stone, or on a relatively slowly revolving wheel with water coolant. But it is possible to take off a short thin sliver by angling the saw into the job at an angle (as fast as it tries to push its way out of the cut, the anglularity steers it back in again). With care this will work without applying lateral thrust or twisting force on the wheel.

Glasses and plastic

Glass has the advantage of abrasion resistance relative to polymethylmethacrylate (such as Perspex®, Shinkolite®) or polycarbonate (such as Lexan®). On the other hand, glass lacks the shatter resistance of polycarbonate and the ease of cutting of both of these plastics.

"Hard" glass is harder, tougher and more heat resistant than common or "soda" glass. It also has a lower linear coefficient of thermal expansion than soda glass, which led to its use in earlier times to make telescope mirrors — until special ceramics with near zero coefficient appeared. The main ingredient of "hard" glass is borosilicate; and the original and best known form is Pyrex® (a trade name that has now become a generic word). Its softening point for working is way above that of soda glass, so a hot blow-torch is required to work it. Borosilicate glass is recommended for water gauge glass tubes because it is better in just about every respect. The low coefficient of expansion doesn't help us, because it is way below brass and copper anyway. Flexible jointing such as cork, neoprene, teflon or silicone is therefore required for mounting any glass. The blue stripe that distinguishes Schellbach tubing causes any fluid level meniscus in the tube to act as a lens that images the line into a pointer, which then highlights the exact top of the water level. That doesn't stop disasters due to blocked water passages. The AMBSC Boiler Code now specifies a minimum 3mm bore for tubes and passages to minimise the risk of blockages, air locks, and the misreading of levels. It doesn't yet specify Schellbach or borosilicate glass tubing, but perhaps on past history we should expect this in short order (not that I am recommending it be mandatory.)

The problem with hard glass is that cutting it by breaking and simultaneously producing neat square ends is difficult. With the diamond saw it's easy!

Diamond sawing will never take the place of conventional glass "cutting" because it isn't cost or time effective for long straight cuts. It's too slow and the wear on the blade with long cuts is unacceptable. However, for forming intricate small pieces accurately, it is the best tool if not the only one. Above all, it doesn't require a glazier's skill with that diabolical little wheel to do it!

Steam Chest

with Dave Harper

Hi there, steam fans, here we go with another collection of steam notes and news.

I have so many bits of reader feedback, news and other items that I've decided to give the historical notes from Burgh's Modern Marine Engineering a miss for this issue; apologies to those who have shown keen interest in that material, there'll be more next issue!

Queensland Museum collection feedback

The pictures of steam engines from the Qld Museum collection in the May/June Steam Chest generated quite a lot of interest; the mystery turbine-driven pump was identified by several people, as a five-stage centrifugal pump of the type commonly used from the 1940s onwards as boiler feed pumps.

It was explained to me that modern boilers run at such high pressures and use so much water that the old type of reciprocating pump would be totally inadequate. Consequently, the centrifugal pumps were developed to operate at high pressures and feed rates, and are driven either by steam turbines or electric motors, sometimes by both!

This information came from several sources including my old mate Dave Sampson, and Gill Tetley from Qld, who sent me a great coloured brochure from Weir Pumps Ltd. This has a cutaway drawing of the latest type of cartridge design which allows all the working parts to be removed as a unit from the main casing, and replaced with a spare unit whilst the original is repaired.

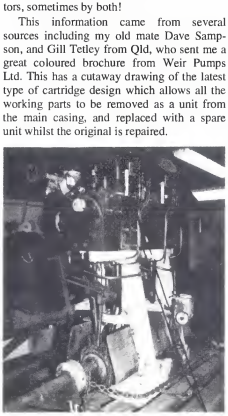


Photo 1.

Peter Hall from Qld., also sent me some reminiscences of his experience as a maintenance fitter in Rockhampton Power Station. He recalls that there were seven or eight of these pumps of which two had steam turbines on one end and electric motors on the other. This enabled the pumps to be steam powered in an emergency. There was also a barring arrangement to keep the pump shaft turning to avoid bearing damage from vibration of nearby machinery when the pump was idle. It consisted of a slow moving electric motor and gearbox with a leather belt connected to the pump shaft coupling.

It also appears that the pumps were generally either five or seven stage, according to the output pressure required.

While these modern pumps may be very efficient, they aren't nearly as interesting to watch in operation as the old reciprocating pumps! Not so easy to make models of, either.... Thanks for all the feed-back, fellers.

Triple compound puzzle

No-one has yet come up with any further information on the Simpson Strickland triple expansion engine pictured from the same collection. However, I do have some pictures now of a similar engine, this time a twin compound with a similar set-up, ie Stephenson's link motion on the LP cylinder and a Myer-type expansion valve on the HP.

This engine was acquired by Geoff Dunnett of Sandgate, Qld., and originally came from the Naval Training College at Rockhampton. Built by W Sissons & Co. of Gloucester it appears tailor made for training as the crankshaft can be uncoupled between the cylinders and there is provision for attaching an indicator to each cylinder in the piping from the drain cocks; these have three-way cocks in the lines with off-drain-indicator positions. **Photos 1** shows the HP end, **photo 2** shows what I was up against trying to take the photos! Crammed into Geoff's shed, the engines sit on old 2ft gauge cane wagon frames. This photo also shows, in the foreground a neat compound launch engine complete with condenser bought at the same sale in Rockhampton. No makers plates were visible, but lying on its side didn't make inspection any easier!

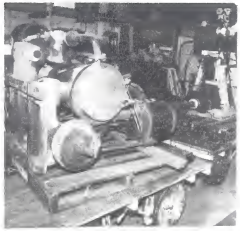


Photo 2.

Wrong again?

Another item from the Qld Museum collection, the engine I assumed was a Willans centre valve steam engine (photo 6 on page 21 May/June 96 issue) stirred the memory of Dave Sampson. He smartly sent me copies of articles from Model Engineer dated 13 June 1957 and 1 July 1965 by Kyrle W Willans, son of the inventor of the centre-valve engine. The articles show pictures of an identical-looking 3-cylinder launch engine of which 500 were built between 1880 and 1888. In the latter year a fire destroyed the factory and demand for the centre-valve engine became so great that this type of launch engine was discontinued.

This engine had extensions to each piston which controlled steam supply to the next cylinder in line, 1 to 2, 2 to 3, 3 to 1. This gave

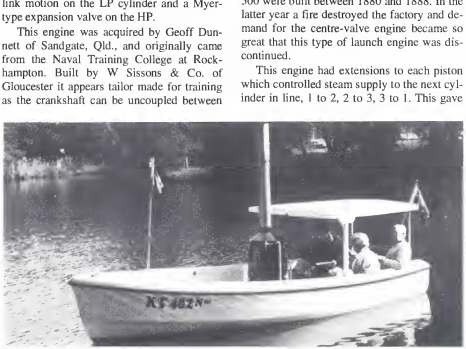


Photo 3.

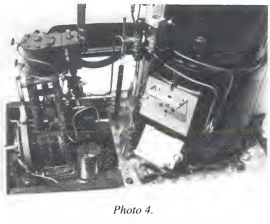


Photo 4.

rather long steam passages and difficultics in adjusting cut-off.

The full descriptions are rather long and confusing, and neither of us is convinced we fully understand them! However, it does seem to show that the Museum's Willans engine is not a centre valve type but an earlier, and probably rarer, type. Must tell Chris Lloyd some time...

Steam launch *Cockatoo*

While on the subject of launch engines, a letter arrived just in time for this column from Bob Quinn of NSW.

A couple of years ago (AME No55, page 15) we published some photos of the launch engine that Bob had built.

He has now completed the whole project and has sent me some photos of his launch which had its maiden voyage in February this year.

Photo 3 shows the *Cockatoo* cruising on the Wyong River in NSW in June this year, looks a very neat unit. It is 16ft long x 6ft 6ins beam x 16inches draught. The hull started life as a *Dolphin* by Savage c1972.

Photo 4 shows the engine which Bob designed and built; it is of 3" bore x 3¼" stroke, double acting, slide valve with Stephenson's link motion. It drives a 13" diameter x 28" pitch 4-bladed prop. The vertical firetube boiler was supplied by Strath Steam, an advertiser in this magazine!

Another odd engine

Also arrived just in time for this issue was a welcome letter from John Single, a regular correspondent from NSW.

John had apparently been touring around the NSW South Coast and near Bateman's Bay at a village by the name of Mogo, he stumbled across a collection of old mining machinery. There are apparently plans afoot to recreate an old mining town.

Among all the gear John spotted and photographed the old engine in **photo 5**. As John says, the column and flywheel seem far too massive for the size of the cylinder.

A study of the picture reveals several interesting points: firstly, this type of engine is very old, dating back to the 1850s or earlier, it was only later that the "inverted" steam engine with the cylinder at the top evolved.

Secondly, the fabricated pulley is an anomaly next to the great cast flywheel.

Thirdly, there appears to be a skew gear on the centre of the crankshaft, hardly an item in keeping with the vintage of the design! Also, there appears to be an eccentric on the far end of the crankshaft, as if there should be a second cylinder on that side. However, the cast base clearly has no provision for a second cylinder to sit on it.

Photo 5.

Finally, I would suspect that the outboard bearing which is mounted on the timber frame would have originally been mounted in the wall of the engine house, a very typical early arrangement.

John feels the "tuning fork" connecting rod may not be original, although the design is in period. Altogether quite a collection of mysteries for one old engine! Anyone out there know anything about it? Thanks anyway, John, for passing on this gem for our readers.

Future attractions

I've recently received a load more photos and information on the Austral Otis engines in the Spotswood Pumping Station in Melbourne. These were provided by Kevin Eisfelder, one of the volunteers who work on these huge old pumping engines. It now remains for me to put all the information into an article for AME — this I plan to do ASAP! Spotswood must be one of the most significant industrial archaeological sites in Australia, and the engines represent the pinnacle of reciprocating engine design. They would be quite a modelling challenge!

I've also got quite a bit more on the Queensland Museum collection and lots more Dave Sampson miniature masterpieces to go!

Speaking of which, here's a couple more examples of Dave's handiwork — **photo 6** is a ⅜" x ⅞" horizontal engine complete with operating governor. In an attempt to reduce friction in the operation of the governor, the major problem at this small scale, Dave has made the operating spindle of the governor valve rotate with the rest of the works.

Finally, **photo 7** shows a duplex launch engine with bores and stroke of ⅜", trunk guides (apparently common on this type of engine) and Hackworth valve gear.

That's all for this time, happy steaming!

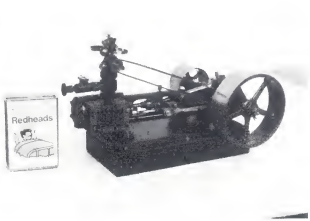


Photo 6.

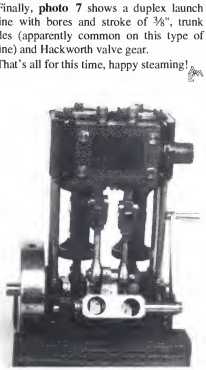


Photo 7.

Valve Event Diagrams

Part 1

by Jack Henshall

Drawings for publication by Rod Heslehurst

Photo by Hugh Elsol

Historical reports of the operation of main line steam locomotives record many incidences of fast running at 20% cut off, occasionally even 15%, but very few reports cover the other significant valve event timings and port openings resulting from use of such cut-offs. Such matters are most readily examined by valve event diagrams and what surprises, these reveal maximum port openings for steam inlet very little more than the lead given to the valve, with release and compression not much later than half stroke, seemingly impossible conditions to provide the power for express operation. So let's explore the construction of a typical valve event diagram and see what information can be obtained.

A number of different valve diagrams were invented at the time of early development and improvement of the steam engine, those most commonly used being the Zeuner, the Revleaux (also known as Mueller or Sweet) and Bilgram's. All give similar information applicable to valves having a basically sinusoidal motion at a fixed phase relationship to the engine crank. It must be noted that the common valve gears — Stevenson, Allan, Gooch, Walschaert, Baker, Joy, Hackworth, Marshall, Stong/Southern, Bremme, Heywood/Greenly — to name some, provide basically sinusoidal motion with rotation of the crank. Only non-linear cam driven valves are outside this consideration.

Bilgrim's valve diagram introduction

Having been initiated to the ritual of Bilgram's in my youth, this form has continued to be used to determine laps, valve travel and angle of advance to meet valve opening and cut-off requirements for numerous engines and therefore will be used to introduce these simple diagrams to recent recruits to steam engineering. The diagrams serve two primary purposes — to examine valve event timing for given valve dimensions, travel and eccentric setting, and to determine the valve dimensions, travel and angle of advance to obtain specified port openings and valve timings. The valve diagram relates solely to the valve and its movement, not to the design of the valve gear providing the movement; but without a valve diagram the analytical design of a valve gear, particularly radial gears, would be most difficult.

The terminology used in flat and piston valve arrangements is briefly reviewed to co-relate the valve dimensions with the information required for, and obtainable from, the event diagram.

Valve events

Admission, Cut-off, Release and Compression. These main valve events, the titles of which are self explanatory and well known, are normally expressed as the percentage of the stroke of the piston moved from the previous dead centre of the crank, at the relevant event in the operating cycle of the valve. This presentation of these events provides an appreciation of the theoretical operating conditions in the cylinder and allows convenient comparisons of the affect of changes in valve dimensions or timing, or with other engines.

Steam and exhaust laps

Figures 1a, 1b and 1c show a common D flat slide valve in its mid position on the port face of a cylinder, all having positive steam lap as needed for expansive working of the engine. Zero, positive and negative (or exhaust clearance) exhaust laps are shown in Figures 1a, 1b and 1c respectively.

Figures 2a, 2b and 2c show a piston valve with inside admission in its mid position in the valve chest; again all have positive steam lap with zero, positive and negative exhaust laps in Figures 1a, 1b and 1c respectively. The laps of a piston valve arranged for outside admission are comparable to those of the D slide valve.

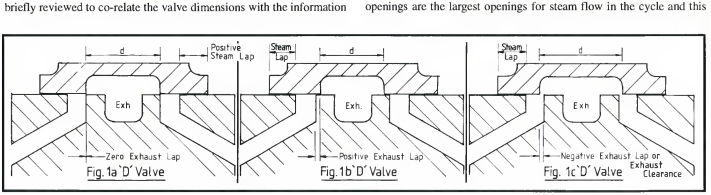
Lead

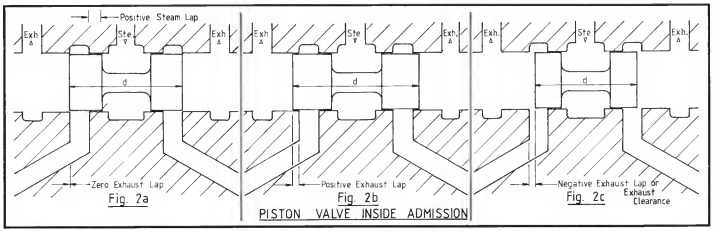
The timing of the valve motion can be arranged so that steam is admitted to the cylinder as the piston approaches the end of its stroke i.e. as the crank approaches dead centre. Lead is the valve opening to steam when the crank is at dead centre.

Valve travel is the distance moved by the valve between the extremes of its travel, i.e. it is twice the throw of the eccentric or its equivalent. The valve travel is not constant but varies as the engine is "linked up" to change the cut-off.

Port opening

The port opening is the distance the valve uncovers the cylinder in the port face at any point in the engine cycle. The maximum port openings are the largest openings for steam flow in the cycle and this





term, unless qualified as exhaust port opening is taken to refer to the opening for steam admission to the cylinders. The maximum openings for admission and exhaust will not be equal for valves with steam lap, and it is unlikely that either will be equal to the width of the cylinder's port in the port face of the cylinder block, the maximum opening for steam admission probably being less that the port width and the movement of the valve for exhaust greater than the port width. As the cut-off in the cylinder is made earlier by "linking up" the maximum port openings will reduce. Port openings are one of the major features shown by valve event diagrams.

Angle of advance

A valve without lap is required to be at the centre of its travel in mid position with neither port to the cylinder open when the piston is at the end of its travel, i.e. the valve motion is said to be 90 degrees out of phase with the piston motion.

For D valves or outside admission piston valves the valve motion is ahead of, or leading, the piston motion, see Figure 3a. For inside admission piston valves, the valve is behind or lagging the piston, see Figure 3b.

When the valve is given steam lap, the valve motion requires to be further advanced for earlier movement of the valve away from its mid position in order that the valve is commencing to open the port to the cylinder when the piston moves through the end of its travel. This advancement of the valve drive ahead of the nominal 90 degree difference between the valve and piston motion is termed "Angle of Advance" as shown Figures 3a and 3b.

Construction of a Bilgram's diagram

Conventions: in my initiation to this diagram, it was customary to draw the diagram for all engines, whether horizontal, vertical or inclined in a similar (or conventional) manner, as then the diagram and its features become recognisable and understood. These conventions are:

(a) cylinder centre line/piston stroke horizontal

(b) cylinder located to the left of the crankshaft

(c) engine rotates clockwise

(d) the eccentric/valve rod length is large relative to the eccentric throw and thus the angularity of this rod can be neglected

(e) the valve events for the stroke with the piston moving inwards towards the crankshaft are examined before those for the return stroke.

Crank angle / piston position relationship

Bilgram's diagram displays the valve events in relation to the rotation of the crankshaft, not to the piston position in its stroke. The determination of the piston position as a percentage of the stroke is not an essential part of the valve event diagram, but is readily included in its construction. However this rather overcrowds the diagram and for purposes of explanation, it is thought best to treat it separately before examining the event diagram.

In Figure 4a, OC represents to scale the radius of the crank arm, i.e. its throw, at a position C in the travel of the piston from the head end of the cylinder towards the crankshaft end, i.e. the in-stroke, on the crank circle ACBC'. CR represents the connecting rod drawn to the same

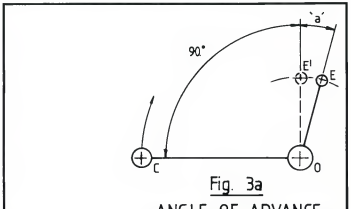


Fig. 3a

ANGLE OF ADVANCE
D VALVE

For both Figures 3a and 3b:

OC = Crank position

OE' = Eccentric position for zero lap zero lead valve

OE = Eccentric position for positive lap valve

a = Angle of advance

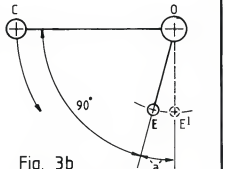


Fig. 3b

ANGLE OF ADVANCE
PISTON VALVE
INSIDE ADMISSION

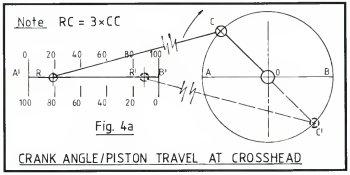
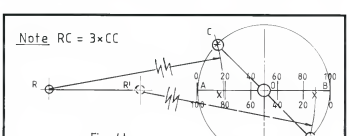


Fig. 4a

CRANK ANGLE/PISTON TRAVEL AT CROSSHEAD



scale, R being the position of the little end along the travel of the crosshead A′B′; the piston being connected to the crosshead is at a similar position in its stroke.

The positions C′R′ are the crank and little end positions respectively at an equal angle of crank rotation in the travel of the piston from the crankshaft end of the cylinder towards the head, i.e. the out-stroke.

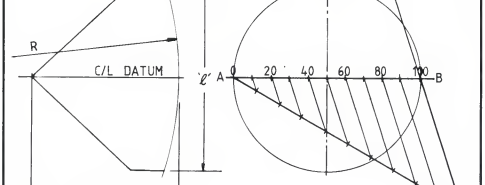


Fig. 4c: PERCENTAGE TRAVEL TEMPLATE
R = n.AB
'L' not less than AB

Fig. 4d: DIVISION OF AB INTO 10 EQUAL SPACES

The ratio

$$\frac{A'R}{A'B'} \times 100$$

is the percentage of the stroke travelled by the piston at crank position C, whereas

$$\frac{B'R'}{A'B'} \times 100$$

is the percentage of the stroke travelled by the piston at crank position C′. It is obvious that no matter to what scale this diagram is drawn, providing the ratio

$$\frac{\textit{con rod length}}{\textit{stroke}}$$

is constant, the percentage ratios will not change.

The numbers above the line A′B′ are the percentages for piston travel on the in-stroke, and those below the line, the percentages for travel on the out-stroke. For an angle 'a' of crank rotation equal to 45 degrees and a conrod to stroke ratio (usually designated 'n') of 3, these percentages of travel are respectively 16.7% and 12.6%. The difference in these travels is due to conrod angularity, the principal cause for differences in the valve events for the in and out strokes. The larger the conrod to stroke ratio the less the differences in the valve event timings, for locomotives 'n' values of about 3 to 5 can be expected, whereas for vertical marine engines 2 to 3 are more likely. A Scotch yoke and slider connection between the piston rod and crank, which has advantages for vertical marine engines in models, has the effect of a conrod of infinite length and so the valve events may be identical for both strokes if the laps and leads at each end of the valve are equal.

As an alternative to the method of Figure 4a, which provides the percentage of travel at a given crank position as a proportion of A′B′, the construction as shown Figure 4b may be used. This provides the percentage of travel as a proportion of AB, which is somewhat more direct for use with Bilgram's construction. In this Figure OC is again the crank arm, and CR the connecting rod, with AB being the distance between the inner and outer crank dead centres, i.e. the stroke. An arc of radius CR, with centre R is drawn through C to intersect AB at X. The percentage of stroke completed is similar to that in Figure 4a i.e.

$$\frac{AX}{AB} \times 100$$

Such arcs will be required for each of the valve events on each of the inward and outward strokes, eight in all for each diagram. In the development of a valve arrangement, it is likely that a number of different valve configurations at a number of cut-offs will be examined, requiring many arcs to be drawn. A simple template as shown Figure 4c, cut from stiff car or thin sheet metal will well repay the time taken for its making and also will save paper in the preparation of the diagrams.

To divide AB into 10 equal parts as a scale for reading percentages, the parallel intercept construction shown Figure 4d is useful. A line AY is drawn at an angle of approx 30 degrees to AB and marked with 10 readily measured equal spaces finishing at Y. BY is joined and lines parallel to BY through the equally spaced points on AY will divide AB also into 10 equal parts.

Bilgram's diagram examples

The intention of this article is to show in a simple, step by step procedure the construction and use of this valve event diagram, not to detail its proof, which can be found in numerous engineering texts, for those interested Reference 1 in Part 2 of this article is probably that most readily available here.

It is thought that the construction would be best understood by preparing the diagram for simple non-reversing D valve engine for which the relevant dimensions are known and then seeing what information can be extracted from the construction

Exercise 1

The engine dimensions required for the valve diagram are:

Stroke	2 inches, n = 3½
Connecting Rod Length	7 inches, n = 3½
Valve Travel	⅝ inch
Angle of Advance	33 degrees
Valve and Port Face Dimensions —	See Figure 5

In accordance with Figure 1a the laps for this valve are:

Steam Lap	5/32 inch
Exhaust Lap	zero

(As steam seems to belong to the era of Imperial sizes and somehow I haven't yet the feel for metric measurements in this nostalgic exercise, there just doesn't seem to be any reason to spoil my enjoyment by straight out conversion of Imperial to Metric.)

1. In Figure 6a, the scale of the circle to be drawn with centre O, the

diameter AB of which represents the valve travel, is chosen so that the actual size is about 3 inch diameter in order that the diagram is not crowded and that the information scaled from the construction is of adequate accuracy. For fractional Imperial dimensions scales of ×2, ×4, ×8 etc., are convenient and for metric or decimal Imperial ×5 and ×10 are preferable. For our 5/8 inch valve travel a scale of ×4 gives a circle of 2½ inch diameter. The line AB is along the cylinder centre line.

2. Anticlockwise from OB mark off the angle BOE equal to the angle of advance (33 degrees for this exercise), E being the intersection point of OE with the valve travel circle.

3. With centre at E draw a circle with a radius equal to the steam lap scaled as for the valve travel (i.e. 5/32" lap ×4 = 5/8" radius) This is the steam lap circle. As the valve has zero exhaust lap, no exhaust lap circle is required and point E is the significant point for determining the exhaust controlled events of release and compression. Valves with positive and negative exhaust lap will be considered later. The Bilgram's diagram is now basically completed as far as input of information for this example. Further construction relates to determining the information that can be obtained on the characteristics of the valve's operation.

4. *Port Opening.* The port opening for steam admission at any crank position such as OC is given by constructing a line at right angles to the crank position (OC) passing through E (EP Figure 6b) and scaling the intercept length from P to the steam lap circle (PL). For a crank angle of 45 degrees as drawn PL is 0.6 inches, with × 4 scaling the port opening is 0.6/4 = 0.15 inches. Similarly the exhaust port opening at a crank angle of 45 + 180 = 225 degrees would be the distance EP (measures 1.22 inches) or 0.31 inches of port opening. Obviously the maximum port opening for steam is represented

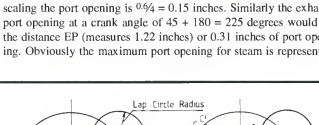


Fig. 6a
BASIC BILGRAM'S CONST.

Fig. 6b
PORT OPENINGS & LEAD

Fig 6a:

Lap circle radius = Lap × Scale = 5/32 × 4 = 5/8"

Angle of advance = Angle EOB = 33°

Valve travel circle: Diameter AB = Valve travel × Scale = 5/8 × 4 = 2 1/2

Fig 6b:

$$\text{Port opening: Crank angle} = 45° = \frac{LP}{Scale} = \frac{0.6}{4} = 0.15"$$

$$\text{Maximum port opening} = \frac{L'O}{Scale} = \frac{5/8}{4} = 5/32"$$

Crank angle at max. port opening = C'OA = 57°

$$Lead = \frac{L''P'}{Scale} = \frac{0.06}{4} = 0.015"$$

Note: $Sin\ a = \dfrac{Lap + Lead}{Lap + PortOpening}$

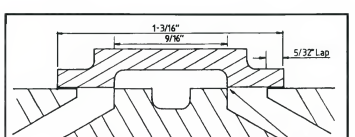


Fig. 5
PORT & VALVE DIMENSIONS

by L'O and for exhaust EO.

5. *Lead.* Lead is the port opening to steam with the crank on the dead centres A and B. Hence the distance from AB to the steam lap circle on a line at right angles to AB through E, (P'L" in Figure 6b) is the lead. P'L" measure 0.06 inches, the lead thus being 0.015 inches.)

6. *Valve Event Timing.* The valve events of cut-off, release, compression and admission occur at the crank angles at which the valve has just closed or just about to open the cylinder ports (i.e. the valve opening is zero). Thus the crank positions for these points must be when PL and PE equal zero. This occurs when the crank angle positions are tangent to the steam lap circle or passes through E for the exhaust controlled functions. Figure 6c shows the diagram with

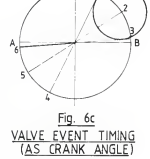


Fig. 6c
VALVE EVENT TIMING
(AS CRANK ANGLE)

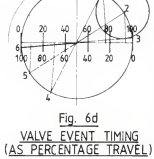


Fig. 6d
VALVE EVENT TIMING
(AS PERCENTAGE TRAVEL)

VALVE EVENTS	Inward POINT	Stroke CRANK ANGLE	Outward POINT	Stroke CRANK ANGLE
Admission	6	-3°	3	-3°
Cut-off	1	116°	4	116°
Release	2	147°	5	147°
Compression	5	-33°	2	-33°

TABLE 1 VALVE EVENT TIMING (Fig. 6c)
Crank Angle from appropriate dead centre
Exercise 1

VALVE EVENTS	Inward POINT	Stroke PISTON TRAVEL	Outward POINT	Stroke PISTON TRAVEL
Admission	6	-1%	3	0%
Cut-off	1	76%	4	70%
Release	2	94%	5	91%
Compression	5	-9%	2	-6%

TABLE 2 VALVE EVENT TIMING (Fig. 6d)
Percentage Travel from appropriate dead centre
Exercise 1

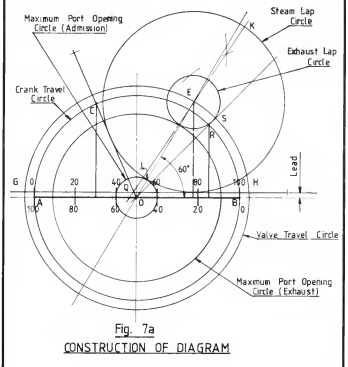


Fig. 7a
CONSTRUCTION OF DIAGRAM

Port opening = OL = $1/16 \times 4 = 1/4$"
Lead = $1/64 \times 4 = 1/16$"
Steam lap = $\frac{EL}{Scale} = \frac{1.12}{4} = 0.28\ (\frac{9}{32}$")
Valve travel = $\frac{2 \times OE}{scale} = \frac{2 \times 1\frac{3}{8}}{4} = 1\frac{1}{16}$"
Angle of advance = EOB = 60°
Exhaust lap = $\frac{ES}{scale} = \frac{3/8}{4} = 3/32$"

these crank angle positions shown, and with their intersection points with the valve travel circle identified in a clockwise direction from A, as positions 1 to 6. Table 1 shows the crank positions as numbered for each of the valve events of cut-off, release, compression and admission for both inwards and outwards strokes together with the angle of crank rotation from the appropriate dead centre.

7. *Percentage Piston Travel.* The percentage of piston travel at each of the main valve events can be readily determined by accepting that the valve travel circle can also represent the crank arm travel, albeit to some other scale (i.e. AB represents the stroke). The actual scale is not important providing the template used to determine percentage of travel as in Figure 4c, is correctly radiused at 'n' times the valve travel circle diameter i.e. for this example at 3½ x 2½ inches = 8.75 inches radius. With AB divided into 10 equal spaces and drawing the arcs through points 1 to 6 as in Figure 6d, the percentages of piston stroke completed at each of the valve events for inwards and outwards strokes can be readily estimated. Table 2 shows the required information for this example.

8. *Summary of Exercise 1.* This initial exercise with Bilgram's diagram is now complete, it is seen that given valve travel, angle of advance and valve laps, the percentages of travel and crank angles for each of the main valve events the lead and maximum valve openings can be found. For clarity in describing the procedure, four Figures have been used, normally the work is done with the one construction, which obviously requires careful notation if confusion in the first few exercises is to be avoided. With experience this appearance of complexity disappears and the diagram can be quickly constructed and interpreted. The next exercise is to use somewhat the reverse procedure to determine valve and eccentric details to meet specified valve timings and port openings.

Exercise 2

The design of a D valve and its eccentric drive is needed for a long stroke, slow speed engine such as could be used in mill operations, or perhaps paddle steamers, particularly stern wheelers. The valve events have been specified for an early cut-off and late release for economical operation. The design requirements are:

Stroke	3 inches } n = 3.33
Connecting Rod Length	10 inches } n = 3.33
Cut-off (nominal)	30%
Release (nominal)	85%
Lead	$1/64$ inch (0.016")
Maximum Valve Opening — (Steam Admission)	$1/16$ inch

As has been shown earlier, the valve events on the inward stroke, differ from those on the outward stroke for a symmetrical valve. The nominal cut-off and release points specified are expected to be approximately mid way between those for the two strokes. The actual cut-off and release points will be obtained from the diagram when completed. Again a sequenced procedure will be followed.

1. *Crank Angles.* Bilgram's diagram is based on crank angles at the valve events, not percentages of piston travel, thus the specified percentages need to be converted to crank angles. In Figure 7a, a circle to represent the crank rotation with centre O is drawn with a diameter AB chosen so that it is readily divided into 10 equal parts, hence AB with ¼" divisions is 2½ inches. Assuming that the connecting rod is of infinite length, vertical lines at right angles to AB are drawn at the 30% and 85% travel points for the inward stroke. The intersections of these lines with the crank circle are identified C and R respectively as shown in the Figure. The lines OC and OR give the nominal crank angles for cut-off and release. Figure 6c shows that the steam lap circle is tangential to the crank angle OC.

2. *Maximum Port Opening.* It is seen in Figure 6b that the maximum port opening is the distance from the centre of the valve travel circle which will be drawn later with centre O, to the lap circle. A scale for the Bilgram's diagram has now to be chosen so as the data is fractional Imperial, let's try ×4; *this may be found too small for accuracy or too large for the drafting facilities — it can be changed if unsuitable. A circle designated the maximum valve opening circle is drawn with centre O and radius equal to the scaled maximum valve opening, i.e.* $1/16$"$\times 4 = 1/4$" *radius — see Figure 7a. The steam lap circle touches this valve opening circle.*

3. *Lead Line.* Figure 6b shows that the lead is the distance from the engine centre line (AB) to a line drawn parallel to this tangential to the steam lap circle. In Figure 7a line GH is drawn parallel to AB and at a distance equal to the scaled lead (i.e. $1/64$"$\times 4 = 1/16$") from AB. This is the lead line and the steam lap circle will be tangential to it.

4. *Steam Lap Circle.* In Figure 7a there are now three boundarics to which the steam lap circle must be tangential, i.e. the cut-off crank angle line OC, the maximum port opening circle and the lead linc GH. By trial and error methods the centre of the lap circle and its radius can be found. This is assisted if the angle between CO and GH (angle CQH in Figure 7a) is bisected using normal geometrical construction as indicated. The centre of the lap circle (point E) lies along this bisecting line and a radius for the steam lap circle can soon be found so that this circle is tangential to OC and GH and touches the valve opening circle. Scaling the radius of this circle gives the steam lap required for the valve, i.e. 1.12 inches divided by 4 equals 0.28 inches lap.

5. *Valve Travel and Angle of Advance.* The required valve travel is the scaled diameter of the circle drawn with centre O and radius OE, i.e. (1⅜" × 2) ÷ 4 = 1¹⁄₁₆". The required angle of advance is angle EOB measured from Figure 7a as 60 degrees.

6. *Exhaust Lap.* In Figure 7a as the crank position at the release line OR is not along the line OE, zero exhaust lap will not give release at 85% stroke as required. As the crank position OE is at approximately 77% stroke, i.e. earlier than required, positive exhaust lap as shown Figure 1b is required to delay the exhaust port opening. With centre E, a circle is drawn to be tangential to OR. The scaled radius of this circle (⅜" ÷4 = ³⁄₃₂") is the required exhaust lap.

7. *Valve Event Timing.* The information required for a Bilgram's diagram as in Exercise 1 has now been found and although the valve event timings for the inward and outward strokes can be extracted from Figure 7a, for clarity Figure 7b has been constructed using only that data necessary for determination of the valve event timings for both strokes. The radius of the template to convert crank angle position to percentage of piston travel is cut to

'n' × valve travel × scale of diagram

i.e. $\frac{10}{3} \times \frac{11}{16} \times 4 = 9.16$ *inches*

Table 3 compiled from Figure 7b lists the valve event timings obtained from this exercise. It is seen that those for cut-off and release average close to the nominal requirements.

8. *Summary of Exercise 2.* Using Bilgram's diagram with somewhat of a reverse procedure to Exercise 1, the valve and eccentric drive can be designed to meet specified valve event timings and port opening. It is seen that for early cut-off and late release with a reasonable port opening, a larger than usual steam lap and positive exhaust lap are necessary. Without a large valve travel only modest port openings are possible. In the two exercises undertaken, the valve drive has been from a single eccentric with a fixed angle of advance — not particularly applicable to steam locomotives which need reverse operation and flexibility in power output steam consumption.

So for Exercise 3 in Part Two of this article let's apply Bilgram's diagram to a Walschaert's radial valve gear, and as a practical exercise let's examine that of Simplex, a D valve 0-6-0 of late 1960 vintage, designed by Martin Evans, a popular model, familiar no doubt to many readers.

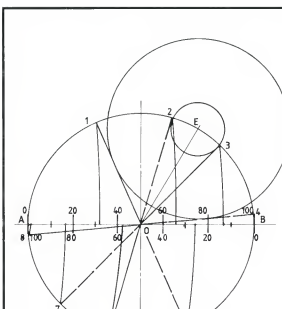


Fig. 7b
BILGRAM'S DIAGRAM

VALVE EVENT	Inward POINT	Stroke PISTON TRAVEL	Outward POINT	Stroke PISTON TRAVEL
Admission	8	-2%	4	-1%
Cut-off	1	32%	5	26%
Release	3	87%	7	83%
Compression	6	-42%	2	-34%

TABLE 3 VALVE EVENT TIMING
Exercise 2

Radial valve gear

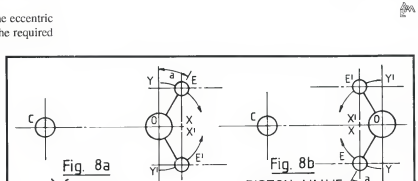
With a radial valve gear, the valve drive is from two independent sources, one providing motion from a point on a line at right angles to the crank and the other from a point on the line of the crank. These, when combined in the correct ratio, give a resultant drive to the valve which is identical to that which would be provided by an eccentric of appropriate travel and angle of advance. Hence if the relationship of the equivalent eccentric to these two motions can be obtained, Bilgram's diagram can be used.

In Figure 8a which is an extension of Figure 3a, OE is the eccentric of radius OE and angle of advance 'a' needed to provide the required valve events with a D valve or outside admission piston valve, for clockwise rotation, OE′ is the eccentric for anticlockwise rotation. The motion from the eccentric OE can be provided by the suitable addition of motions equal to OY phased at 90 degrees ahead of the crank and OX phased at 180 degrees, i.e. opposite, the crank. Reference 1 provides a proof for this. Similarly OY′ and OX′ are the motions required for the reverse direction of rotation. Figure 8b, based on Figure 3b, shows the corresponding motions required for inside admission piston valves. It is seen that in both Figures 8a and 8b OX and OX′ are identical for forward and reverse operation, and OY required only reversal in direction to provide OY′. This is the principle underlying all radial valve gears. The radius of the equivalent eccentric (OE) is such that OE2 = OX2 + OY2 with an angle of advance a such that

$$\tan a = \frac{OX}{OY}$$

Hence reducing OY increases the angle of advance so providing an earlier cut-off. Also as OY is reduced OE is reduced, approaching in magnitude OX. the significance of this is seen when Bilgram's diagram is drawn for 'linked up' operation.

To be continued...



Maritime Matters

with Leigh Adams

Canberra regatta

The next big outing for model boaters will be the annual regatta promoted and run by the ACT Model Boat Club. This event is held at Edison Park in the ACT and is a regatta where all the eastern states get together. This event, held on the first weekend in November, encompasses a night run on the Saturday evening and a full day's running on the Sunday.

Canberra caters adequately for accommodation and heaps of tourist venues to make this a packed and enjoyable weekend for *all* the family. I know the war museum is always on the shortlist when we visit the nation's capital.

For further details on running times and a schedule for this weekend, contact the ACT Model Boat Club Secretary on (06) 258 8516.

Port Macquarie Regatta

Port Macquarie Model Boat Regatta unfortunately fell in an awkward period between issues of AME. Too soon for a report in this issue to let you know what was on and happening. Held at Port Macquarie RSL Club on the 26 and 27 July, this has been organised by the proprietors of Jordan Marine, Port Macquarie Maritime Museum and the local RSL. The Regatta is designed to promote a start of what is to be Port Macquarie Model Boat Club. Modellers from around the state have pooled together to give the locals a kick start for those interested in model boating. I will be travelling to this Regatta for the weekend and will present a full report in the next issue.

3rd Bi-annual Model Engineering Exhibition

Members of the Maritime Model Club of NSW Inc. again have decided to be part of the Model Expo in Melbourne in October. So don't forget to go along to the exhibition and see a wide range of maritime exhibits, including some new vessels built and displayed specifically for this show. See you at the show.

Vice accessories

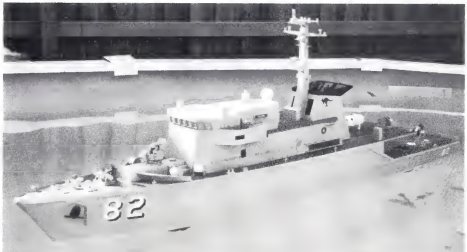
Having owned a HAFCO RF-30 Drill Mill for some time, I have made quite a few jigs for holding and machining components. While building a twin cylinder launch engine for one of my model boats and having to reproduce two of each component, I required some simple jigging to mill out the parts and what was needed was something to register each part in a drill vice.

An adjustable stop fitted to the fixed jaw was the answer. Checking the offcut box, a piece of 1/8" brass was selected and machined in the mill.

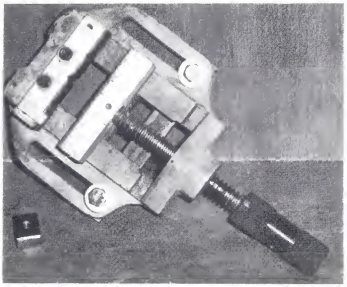
The rear jaw of the vice was marked out, drilled and tapped. Taking extreme care not to break the tap by using plenty of cutting fluid and cleaning the tap of swarf.

Socket head cap screws were used for adjusting the stop bar, these are more positive than a phillips or slotted screws.

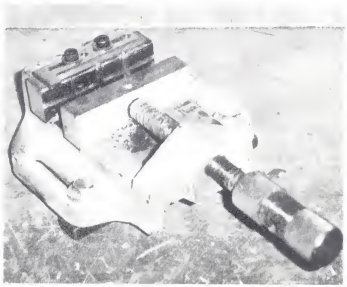
With the stop complete, the vice needed to be set up parallel with the compound table, so



*HMAS **Huon** by Leigh Adams, almost complete. Fitting of hand rails and masts is continuing.*



The adjustable stop fitted to the fixed vice jaw.



Another view of the adjustable stop.

some simple hold down bolts were made and fitted.

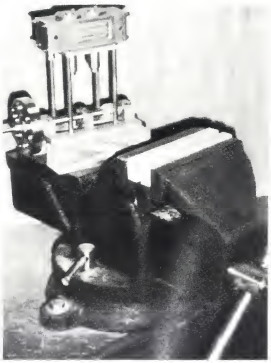
Although only a simple jig and easy to make, I use it nearly every day.

Soft jaws

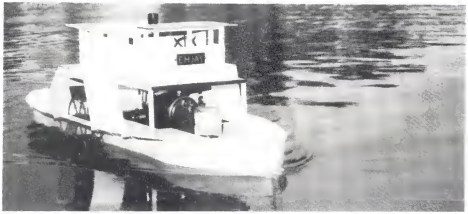
Mainly working with brass, soft jaws on my vice has always been a necessity. I have used aluminium angle stuck on with double-sided tape or sheet brass folded to match the jaws, but when holding small items, they flex and pivot and have been a constant frustration.

I have searched catalogues and hardware stores to purchase some commercial soft jaws without any success, but have found an inexpensive alternative. Department stores have been selling "white" plastic cutting boards for some time, these can be cut and machined to replace the existing jaws in your vice.

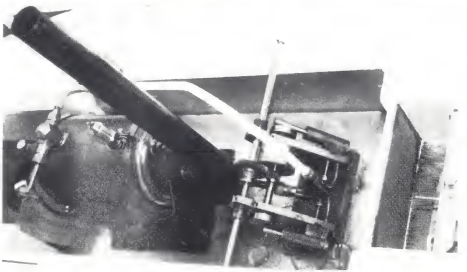
These cutting boards are moulded with a criss-cross pattern which grips the job without leaving any witness marks. Since fitting them I have found they have solved my problem and many of my friends have adopted this approach.



The vice jaws in place. The engine is a twin cylinder unit for a marine application.



*John and Michael Lyas' PS **Emjay** seen at the 1996 AALS Convention.*



*The engine room of PS **Emjay**. Note the twin cylinder oscillating engine and reduction gears to the paddle shaft. Steering is by remote control.*

A 5" gauge NSWGR 422 class Diesel Outline Locomotive

Part 25 (final) of the construction of a battery electric locomotive

Neil Graham describes the bi-centennial colour scheme as applied to locomotive 42218

Colour rendering by Brian Carter. Photos by Brian Carter except where otherwise credited

Early morning light and long shadows give an imposing three-quarter view of 42218 at the observer's eye level, just before he climbs up into the cab to commence the day's duty.

In this final part of the series, I will describe the bi-centennial colour scheme as applied to a single member of the class.

The State Rail Authority (SRA), as part of the NSW Government's involvement in the national bi-centennial celebrations in 1988, sent a selection of their locomotives to the paint shops and they re-emerged with a striking livery. The scheme was applied to two units of the better known classes of locomotives. Two 80 class, two 81 class, one 48 class one 86 class and one 422 class. The numbers of the locos selected for the bi-centennial livery did not appear to follow any pattern. So we can only conclude that the locos so treated were either due for a re-paint after workshop attention or were handy to the paint shops at the time.

42218 was the locomotive selected out of the 422 class and it certainly did not get an overhaul at the same time. 42218 appeared to have had the hex put on it when it emerged with its new livery. Upon return to service it immediately disgraced itself and failed on its first revenue trip. It was repaired, but failed several times in the ensuing weeks. After shopping for further work it settled down for life in the new livery with the reliability that the 422s are known.

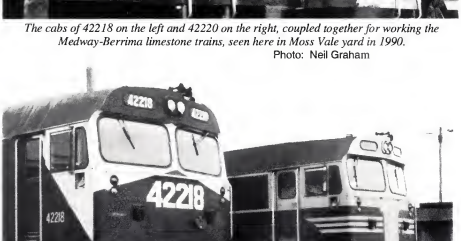
42218 received its special livery in April 1988 and stayed that way until early 1992.

Bi-centennial 42218

- The roof is all over grey to the bottom edge of the mansard for the full length of the locomotive.
- The main body and cab sides are painted alternately striped from the number one end, white, blue, orange, and red to the centre where there is a wide blue stripe, then orange, red, blue and finally the number two cab side which is predominantly white.
- The broad striping is angled at forty five degrees from the bottom to the top towards the number two end on both sides.
- The cab brow is red as is the cab front lower area.
- Carbody underframe, bogies and wheels painted grey.
- The horns are painted orange inside and out.

42218 around the lower mid body area. Note that the white rectangle only goes down as far as the panel strip. The fixing of the "shooting stars" logo is fully described in the text.

The cabs of 42218 on the left and 42220 on the right, coupled together for working the Medway-Berrima limestone trains, seen here in Moss Vale yard in 1990.
Photo: Neil Graham



The two best known of the 422 class locomotives. The No.1 end of 42218 in the foreground and 42220 behind it. The bi-centennial paint scheme treatment of the end is apparent here. As an aside, after 42220 was modified to super series, it became known thereafter as "The Jet", due to its use in mainline high speed trials in 1992.
Photo: Ross Verdich

- The staff exchanger recess is completely covered in on both sides and forms part of the body panelling.

The paint scheme shown in Figure 94 is representative of 42218 during the part of its life when it wore the unique colour scheme.

- All handrails are picked out in white.
- On the model, the windows surrounds painted black to represent the rubber.
- Centre rectangle is white
- Cab steps, bogie steps, door handles, numbers, loco lifting lugs, coupler lever handles, air cock handles, air pipe fittings and fuel filler caps painted white.

Painting tips for 42218

The article by Ross Bishop-Wear in AME Issue 66 May/June 1996 pages 30 and 31 gives the general method of painting locomotives and they are applicable to 42218 as well. Measure and mark where the broad bands need to go on the loco. You may need the just put the tiniest of dots with a 0.2mm tip marking pen at regular intervals along the proposed line of colour change.

The locomotive is then best stripped to bogies, frame, cabs and finally main center body section. Follow the priming and finish coat steps to get the base colours on the various sections.

Again I shall repeat — masking out for the banded sections is not the horror story that one thinks. For a start, I don't use masking tape. Spraying up to conventional masking tape does not give a clean enough edge for my liking. I use *3M Magic tape* of the 20mm wide variety. Lay it along the edge of where you want the line to go, then put a couple of layers of paper overlapping the "overspray" edge of the magic tape, then stick the paper down with tape.

Spray the area/line or striping as required. Now here is where I break the rules. Remove the paper then carefully lift away the magic tape before the paint is dry. You should be left with the very clean edge to your linework. Wait a couple of days for the enamel to cure then mask up the next line and follow the same procedure etc etc.

After the frame and bogies are complete, the bogies can be re-attached to the frame and the drive system re-connected.

Plenty of patience and good forward planning for the locomotive linework should see your locomotive come up a treat and start to look like the part indeed.

Colour strip

The colours of the 42218, while reproduced in this magazine will no doubt not exactly match the shade of the outshopped locos. This is a fact of life with published material. The exact colour is never 100% emulated. So to help our builders get the colours correct, you can send us a self stamped and addressed *Jiffy* bag and we will return to you a small strip of metal with the colours on them. Make sure you specify you want the 42218 bi-centenary colour scheme. You can then go to your local enamel shop and they will mix a brew to exactly match our sample. That is just about a close as you can get.

Bits and pieces

For the outline of the rubber seals which go around the windows, cab number boxes, driver's and observer's window sills (if the windows are partially down) portholes and marker lights, we used *Humbrol* Flat Black enamel. This was applied by brush. A steady hand and a bit of patience is all that is required.

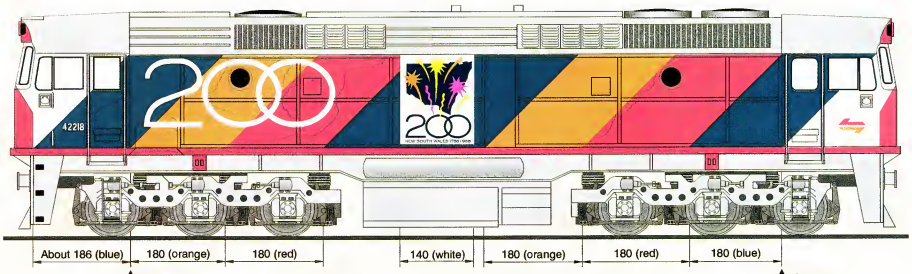
We sprayed all our cab handrails (eight of them) and cab front handrails after sitting them on the ends which fit into the cab . The cab steps were masked off and sprayed. Things like fixed handrails and bogie steps were hand painted.

Finally, the horns need to be finished off in orange, inside and out.

Number boxes

The number boxes of which there are two on each end of the cab above the main windows need to be fitted with their numbers at this stage. The complete method is described in AME issue 66 so does not need repeating here. Just specify 42218 when ordering your numbers kit.

bmc



"Shooting Stars" white panel is located centrally between the vertical rivet strips and from the top of the lower rivet strip to the roof line.

DULUX COLOURS

Red	393 35101 GP3
Orange	393 31158 GP3
Aircraft Blue	393 07358 GP3
Off White	393 33333
Sea Grey	

SUBSTITUTES

Holts Dupli-color Nissan Beacon Red
Holts Dupli-color Tango Orange
Holts Dupli-color Toyota Royal Blue
Holts Dupli-color White Primer
Holts Dupli-color Grey Primer

LOCOMOTIVE COLOUR ALLOCATIONS

Body	= Blue-Orange-Red	Glass surround	= Black
Cabs	= Red-White-Blue	Horns	= Orange
Frame upper	= Red	Air cock handles	= White
Frame lower	= Grey	Coupler lift bar	= White
Cab brow	= Red	All Handrails	= White

NUMBERING

Numbering, logos and "Shooting Stars" of NSW, we suggest computer cut vinyl transfers for all.

Front numbers 35mm high

Figure 94
SRA BI-CENTENNIAL

42218 leads 42220 as they approach Exeter on the Short South with the best part of 2000 tonnes of limestone on the hook, bound for Berrima Cement Works between Moss Vale and Bowral.
Photo: Neil Graham

More windows

While we are putting the finishing touches to the cabs, now is the time to put the main windows and side windows in position. Again the method is described in full in AME Issue 66 so does not bear repeating.

Re-install the window wipers to the loco, nutting them up on the inside. We did make an omission in a previous issue when we described the assembly of the window wipers. Because the wiper assembly mounting studs are so close, the nuts will not run down side by side. We got around this by simply making a small ferrule 3mm long to go over one of the stud ends when they protrude on the inside of the cab. This means that the nuts sit at different heights, but at least they can both be tightened satisfactorily!

The cabs can now be offered to the frame, electrics re- connected and be fastened back onto the frame of the loco.

The installation of the hornsets and handrails are described fully in AME Issue 66.

Locomotive numbers

The method of applying the number are fully described in AME Issue 66. However there are specifics relative to 42218 in the bi-centenary scheme, so I shall relate them.

If you wish to go the vinyl cut method then you can place an order through AME and we will have them cut and forwarded to your order. If you wish to order through AME, then we need the following information.

Name and Postal Address

Your locomotive number (42218) and specify it is for the bi-centenary scheme.

Your return phone number so we can quote the cost. The costs for the Bi-centenary vinyl cuts will will be fairly expensive, due to the one off orders. By the time you read this, we should be able to quote firm prices.

Orders by mail to AME or phone (02) 9646-1053. Fax on (02) 9646-1362. Also can be phone/fax. ordered on (048) 844- 324.

Fixing the numbers

Again, the fixing of the numbers is fully described in AME Issue 66. The fixing of the large "200" is a bit of a problem in that it doesn't want to sit exactly flat on the side due to the raised panel stripping. In the end I ran a scalpel along the top and bottom edge of the panel stripping in way of the vinyl material where it was needed then carefully pushed the vinyl firm in those areas. After the top film is removed, get the pin out and puncture the vinyl at the rivet as previously described in AME Issue 66. You may have some bare metal showing at the cuts in the vinyl in way of the panel stripping. On our locomotive this was touched up with a satin white paint.

No doubt at some stage the "nit pickers" and "rivet counters" will notice these touch ups, but so far in the twelve months since the locomotive was painted, no-one has mentioned them to us.

Shooting stars

The shooting stars insignia presents little challenge if they are applied in a logical and unhurried manner.

Referring to the half size full colour shooting star emblem on this page, you can see the colour arrangement and the positioning. The first thing to do is get this this emblem photocopied to full size (ie. ask for 200%) reproduction. Black and white is O.K. However, we found it best to get it photocopied onto a transparent piece of paper. So, when you go to your friendly photo copy shop, ask for a 200% monochrome reproduction on an overhead projector (OHP) transparency.

The photo on the left shows our 42218 working upgrade in the early evening in southern NSW. The driver has just doused the headlight for the approaching station which has just come into view.

The NSW bi-centennial logo in half scale size.

***Above** shows Bill Abbott's 42206 front at the #1 end with the accumulative hour meter visible through the driver's window.*
***Right** is the same loco looking at the observers side cab with the Freight Rail logo prominent under the observers side window.*
Photos: Bill Abbott

- The first application is for the map of N.S.W. Go through the application procedure and position it approximately. Then alternately hold the transparency over the top of the white rectangle and re-position the state map. Then allow it to fully dry.
- Next position and set the Yellow star, the "wriggly worm" and lastly the "comet".
- The Magenta star is next, followed by its wriggly worm.
- Finally the Orange star and its comet.
- I left the cab numbers and the "Arrows of Indecision" until last.

This completes our treatment of 42218.

Bi-centennial scheme

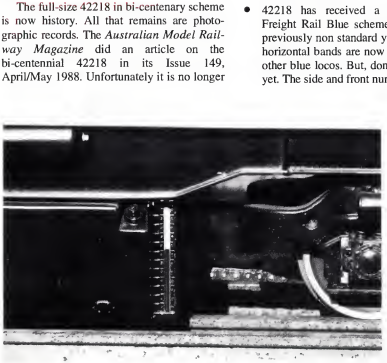
The full-size 42218 in bi-centenary scheme is now history. All that remains are photographic records. The *Australian Model Railway Magazine* did an article on the bi-centennial 42218 in its Issue 149, April/May 1988. Unfortunately it is no longer available. Your only option is to borrow one from your HO scale friends.

Please note that the NSW Bi-Centennial "Shooting Star" logo is copyright to the NSW Premier's Department and we have limited permission to reproduce the logo. It cannot be commercially re-produced.

Update on colour schemes

Since our last precis on the colour schemes (AME Issue 66), some further variations in colour schemes have been noted.

- Our livery table showed that 42208 has been re-painted in Blue. This is incorrect. 42208 was sighted in June 1996 still in the Candy scheme!
- 42218 has received a re-paint of its Freight Rail Blue scheme linework. The previously non standard yellow and white horizontal bands are now the same as the other blue locos. But, don't jump the gun yet. The side and front numbers are a variant style to the other class members. So the locomotive is still not representative of the Freight Rail Blue scheme as applied to most of the class!



***Left** shows the very visible fuel height in Bill Abbott's 42206. His method of showing the fuel level is described in the following boxed story.*
Bill Abbott

The end

This completes the 422 class construction series. We doubt that the 422 will ever be as popular or as numerous as the now ubiquitous 5" gauge C-38s, but we do like to think that it will become the diesel outline equivalent.

Acknowledgements

The successful completion of this project has only been made possible with the help of many people.

The designer: John Hill (one of natures gentlemen) who allowed us to use his design as well as re-designing the drive system for electric motors. He also made his cab and bogie patterns available to a retailer.

The constructors: Brian Carter, Barry Glover, Neville Levin and Neil Graham.

The electronic whizzo: Neville Levin who adapted, de-bugged and refined his comprehensive multiple unit electronic control system for the 422 class, then made the design and hardware available to AME. The electrics as we specified them would have foundered without Neville's tireless efforts.

The retailers: Hawleys for their excellent flame cut steel sections, Hucar for the castings, and Scobie & Glover who have developed and retail a range of "fiddly bits" and castings to make our locomotive look the part.

The many others: Nevin Owen, Bob Hester, Ross Bishop-Wear, Les Sheppard, Bob Irvine, Bob Gallagher, Ross Edmondson, Mark Carney, Bus Ingmire, Bill Abbott, Peter Oetterli, Robert Woolley, Les O'Donnell, Greg Potts, Ross Verdich and Bill Kerr.

Thank you one and all!

Freight Rail 42206

by Bill Abbott

For those of you who are about to embark on the 422 class project, all I can say is "lucky you"! You now have all of the construction episodes and thus you can plan your project accordingly.

Construction philosophy

I have a very simple philosophy with any project and I recommend it to all constructors. Make up your mind to spend a set number of hours per week on the job and stick to it. Do something every day and before you know it you will be rolling at the local track. With this philosophy in mind and sticking to it, it has taken me ten months to get the loco to "trackside" for running trials, then a further four months to complete it.

The time-savers

The suppliers of materials I have found to be mostly reliable, especially Ross Hawley Engineering who did the flame cutting and Scobie and Glover who have supplied a multitude of detail components. They save a swag of time and are well worth the effort rather than make your own.

The descriptions

Generally, if one follows the articles as published in AME, then the result will be very rewarding. At the very beginning, we are advised to keep the chassis flat and straight. Take your time to achieve this, it definitely pays off with an accurate foundation to build on.

In my case, I did not weld the bulkheads to the frame. I found it far more accurate to position and attach them to the frame with 5 x 6mm Unbrako cap screws, each coming through the frame and into the bottom of the bulkhead. Another advantage of doing this, is that when you come to trim up the the bulkheads when fitting the cabs and body sections, you can completely remove the bulkheads and machine the straight edges in the milling machine. This will keep everything straight and square.

A little word of advise on paint preparation. After each component is complete, ensure that you etch prime it. The advantages of this will show up later.

One detail I varied was the fuel gauge. My option was to make it out of solid brass, then fit a 4mm diameter *blue line* glass, sealing on end with *Silastic*, half filling it with red transmission oil, holding the glass and sealing the other end. The result is very effective and stands out like the proverbial.

Patience, patience

If you follow the published articles in sequence you sooner or later will be confronted with the electrics. However, try and curb your impatience and finish off the chassis attachments and bogies completely before proceeding further. You can then paint the chassis and running gear to your colour scheme.

Electrics

To do the electrics in a progressive and orderly way, I recommend you purchase two sets of electrical diagrams. These incorporate all the corrections, modifications and updates published in subsequent issues of AME. First, I fitted in all of the components into their correct location and labelled them. Then you begin to wire them in. After laying in each wire run, I then traced it in with a red marker on my spare copy of the relevant drawing (that's why I purchased two sets). Test the continuity and once satisfied it is correct, continue on. If you follow this method, you will soon find it is nowhere near as complicated as it looks. I know very little about electrics, however, it still only took me three days to wire up. That included the modifications to the motors and the making up of the sound board and the headlights voltage regulator. Barring a couple of very minor hiccups, it all worked straight off!

In addition to the published electricals, I included a 12 volt accumulative lapsed hour meter into the circuit. It goes across the coil of the 70 Amp relay. It thus records the actual running hours. I included the hour meter, to keep an accurate record of battery performance.

At this stage I took the locomotive to the track and powered up! As a result I am happy with the locomotive's performance.

The body

The cabs and body sections as described in AME are straight forward if you follow the published instructions and so need no further comment from me. The only deviation I made was to use *Loctite Speedbonder 324* to assemble the mansard cooling grills rather than the published method of silver soldering. I also added the little hand-grips on the No.2 end mansard grills on the driver's side. The size and location was gleaned from the published photographs.

Speedo?

After reading John Wakefield's article on his SAR class 16F (AME March/April 1996), especially his speedometer description, it is my intention to fit one of these speedos at a later date.

Summary

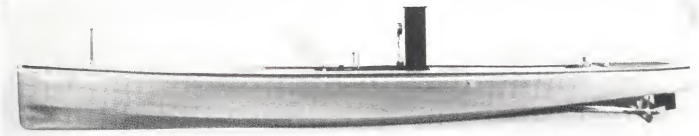
Overall, this has been a very pleasing and rewarding project. Through these pages I would like to thank the AME construction team, also Neville Levin, Peter Oetterli (another 422 builder) and John Dew of Live Steam Supplies for their patience and guidance given to me throughout the project.

Golden Arrow

or Making a Start in Marine Steam

by Leigh Adams

Drawings for publication by Brian Carter. Photos by Brian Carter unless otherwise indicated. Anvil engine design by Andy Smith



A broadside view of the 1.4 metre ***Golden Arrow****.*

A closer view of the bow — note the sleek lines of the golden hull.

Several Golden Arrow design models have been built.
This red hull example is called Red Arrow and was built by Warren Reaney.
Photo: Leigh Adams

While browsing through some model boat magazines, the seed was planted to build a steam powered model boat that would be reasonably simple to build. However, it should capable of high performance with a bit of grunt. Most model boats featured in magazines — while being built along traditional lines — are usually underpowered. These models, while steaming well and moving the vessel at a scale speed, seem to lack any punch! So in planning this project I set down the following selection criteria:

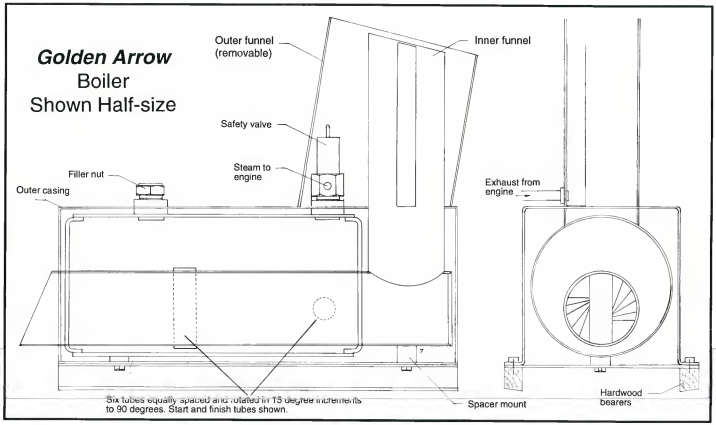
- Simple construction,
- Made from readily available materials,
- Sporty performance and,
- A low budget of around $300 (depending on your resourcefulness) including the two-channel radio control.

There are three major components to consider:

1. Engine
2. Boiler
3. Hull

I've listed the categories in that order because that's how Golden Arrow came about. I found the engine, then designed a boat around it! To meet the selection criteria, these components had to complement each other. An article describing a single cylinder double-acting oscillating steam engine was discovered in a 1989 edition of the *Marine Modelling Monthly* magazine. No castings are required and could be made without a lathe if one is not available — but obviously — a lathe would be a great advantage.

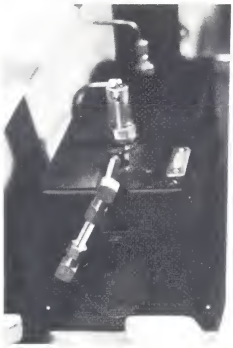
Apart from the engine construction, this article is not intended to be a step by step, drill this hole, tighten that bolt issue, but to describe the combination of parts which give a



proven and satisfying result. Once the engine is completed it can be run on compressed air and will show you the potential of this simple design.

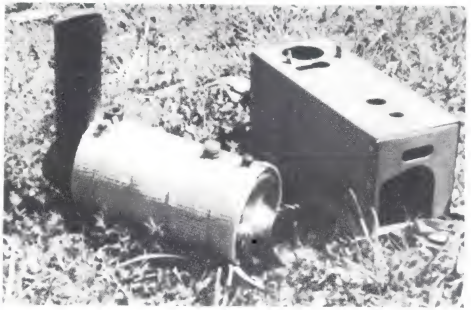
Boiler

The 75mm diameter, 150mm long boiler has been designed to meet the regulations of the AMBSC code. All materials are readily available from the model engineer suppliers advertising in AME. For those building their first boiler it should be noted that all components should be silver soldered or brazed, but before assembling the boiler all the parts should be shown to your club boiler inspector for his approval.



The boiler assembled and mounted in the hull.

Show the boiler plan to an AMBSC boiler inspector for approval before you start anything... ed



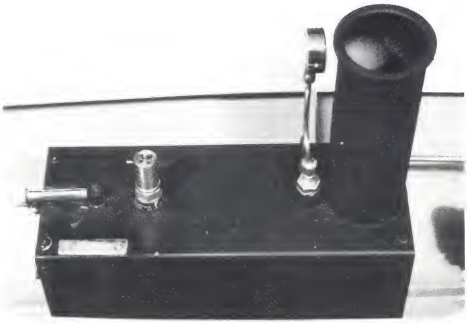
The boiler and steel casing. The lagging used is "Cool It" Thermo-tec automotive exhaust tape.
Photo: Leigh Adams

Hull

The hull while looking like a straight runner, turns well with twin rudders. The hard chine hull is simple to construct using ply. Use waterproof glue and finish with enamel paint inside and out.

The first thing most modellers consider is the size. Mainly for ease of transport to the "pond". The best place to start is to measure the section of your car where the model will be stowed. Unfortunately, at the time, my Holden Commodore had been stolen and I was driving a Mini! At least if it fits a Mini it will just about fit anything!

After determining the length, a rough layout was drawn up on some scrap plywood. The sketch showed a plan and side elevation

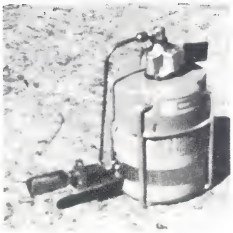


A side view of the boiler.

The propeller and twin rudders.

The engine room of Warren Reaney's Red Arrow. Warren used a Stuart Turner boiler and and single cylinder slide valve engine — circa 1900!

Photo: Leigh Adams.



A standard Primus disposable camper stove bottle is used to fuel the boiler. The burner is a standard primus blowlamp.

Photo: Leigh Adams

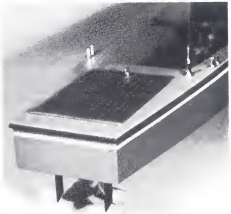
of the hull with the main features drawn in. The engine. prop shaft, boiler, gas bottle, and radio control layout were added to the plan. From these sketches a set of profile were developed.

The frame bulkheads and keel were built up from 5mm ply. They were stood up on the building board and fixed to their station. Doing this gives you an idea of the shape of the hull — even better if you stand on your head! As with normal boat building practice, the hull is built upside down.

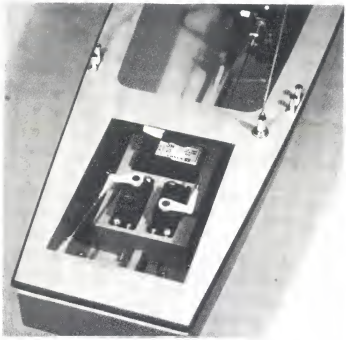
Some stringers were cut from 6mm square timber and fitted to the frame. To fit the outer prop shaft, the keel is laminated on each side where the shaft passes through. The means no drilling through the hull and allows you to line up the shaft accurately. The hull skeleton is now complete.

A hint for sheeting the skeleton. Extra glue blocks are required in the bow and the keel needs to be feathered to allow accurate positioning of the plywood sheeting.

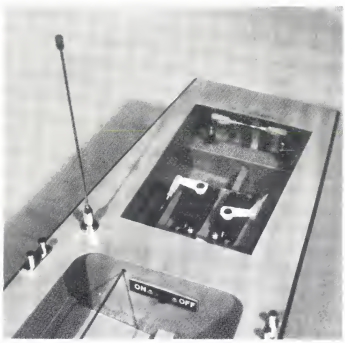
Make up some cardboard templates to determine the shapes for cutting the 2mm ply to sheet the frame. The final shapes were cut



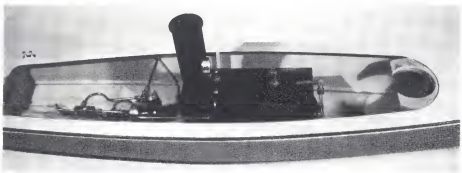
A stern view showing the radio control gear hatch cover. It has a real marine look with the grid pattern.



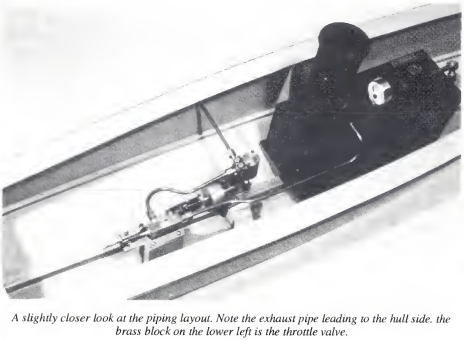
A look at the radio control gear under the hatch.



Another view of the radio gear. Note the linkages and switch.



This view amidships is to give you an idea of the positions of the engineroom plant. The odd-looking circular cut-out on the right is for holding the gas bottle.



A slightly closer look at the piping layout. Note the exhaust pipe leading to the hull side. the brass block on the lower left is the throttle valve.

3mm oversize to allow for trimming after fixing.

The sheeting sequence is: fit the sides first, and trim to size; then fit the bottom and trim to size.

Once the hull is sheeted and cleaned up it can be removed from the building board and turned over. Now it's time to make a work stand. Make it sturdy so that it can be screwed or clamped to the bench as the rest of the construction will be done in the stand.

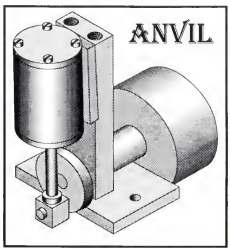
Radio control

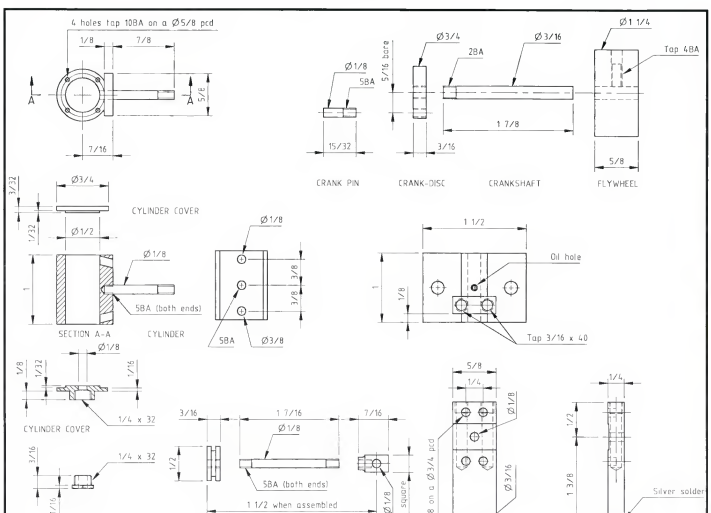
A two-channel radio control unit takes care of steering and the throttle valve. This should be built into the aft compartment and made watertight to protect the electronic equipment. I used a Sanwa Dash unit for *Golden Arrow.*

Engine

Anvil — a double-acting, oscillating steam engine by Andy Smith

' This section has been reproduced with permission from *Marine Modelling Monthly,*





September 1989, page 38. Our thanks to MMM editor Chris Jackson and Traplet Publications UK. Sections of the article not pertaining to the engine have been omitted. Imperial measurements were used to construct the original engine, therefore they are retained during this part of the story... ed.

Andy continues with his description of Anvil's construction...

To gain a bit more power from a simple oscillating engine, the obvious course to follow, is to change it from single-acting operation — where power is only developed on the downward stroke, the return stroke being dependent on the inertia in the flywheel or other driven members — to double-acting operation, so that both downward and return strokes develop power. Having had experience of building a simple, single-acting, oscillator, the reader should have no difficulty in building this more powerful version. Some extra work is needed but nothing more complicated than has gone before.

The engine illustrated here is one I drew up and made some years ago when involved in producing a few designs for commercial purposes. At the time, I named it Anvil, which, as it was built by "a smith", seemed appropriate!

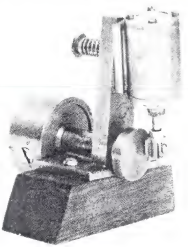
The Anvil engine has a bore of ½" by ⅝" stroke.

Start with the engine frame, construction is straight-forward. However, precise assembly and careful silver soldering are required.

With the frame structure completed, the ⅛" diameter hole can now be marked out at 1⅜" above the centre-line of the 3/16" hole through which the crankshaft fits. This ⅛" hole is for the cylinder trunnion, so needs to be nicely square with the face of the upright. A shallow depression is milled or filed around this hole for the two purposes:

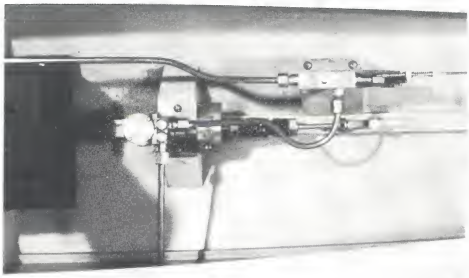
(a) to reduce friction between the cylinder port face and the frame, and

(b) to allow some clearance for the screw-thread burr where the trunnion is screwed into the port face.

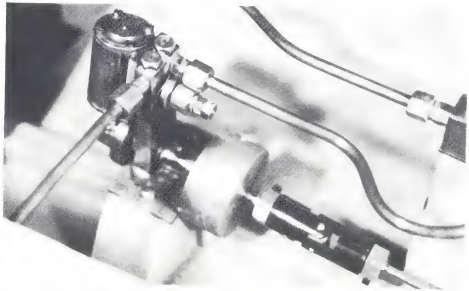


Anvil as viewed from the front.

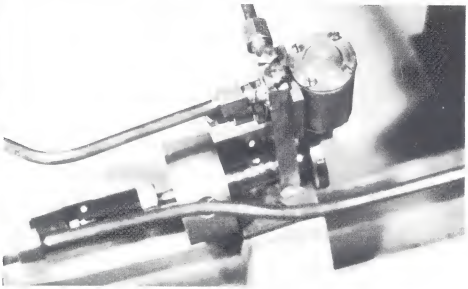
The vertical steam-ways can be drilled in the frame upright at ⅜" centres. It will probably be convenient to use the a tapping size drill for the thread that will eventually be on the ends of the 3/16" diameter steam and ex-



A plan view to show the piping layout.



A close look at the engine. Note the changes from the plan — the wave washer and spacers in place of the coil spring, and the inlet and exhaust steam pipe connection to the engine stand.



Another view of the engine — this time from the other side.

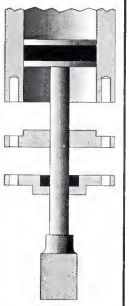
haust pipes; however, do not, at the moment, drill the four 1/8" communicating steam and exhaust ports.

The cylinder block comprises a short length of 3/4" diameter brass bar just over 1" long. Set this vertically in the lathe four-jaw chuck and face 1/16" from one side, leaving a flat to which a length of 5/8" by 1/8" brass flat bar is silver soldered.

Hold the cylinder block in the four-jaw chuck for facing to length and boring to size. Earlier I mentioned that the maximum bore was 1/2", however this can be anything from, say, 3/8" up to this maximum; any larger and the cylinder walls get a bit thin for the cylinder cover screws.

Now mark out the cylinder port face for the threaded trunnion-pin hole, and the upper and lower steam ports; the latter will need to be started using a small centre-drill with the cylinder block set over at an angle of around 14°. The steam ports are shown as 1/8" diameter, but I suggest you start by drilling these 1/16", likewise the four holes in the frame; the latter can be spotted through after the engine has been assembled. For greater output, presuming the boiler will supply enough steam, the ports may be opened up to the maximum of 1/8" diameter shown.

The cylinder covers are simple turning jobs from the rest of the 3/4" diameter bar. If you feel that the gland on the bottom cover is a bit awkward for you, or you don't have the necessary taps and dies, an O-ring may be used; that specified as BS 006 would be correct for an 1/8" diameter piston rod. A drawing is given showing the modified gland. The covers are attached at each end with four 10 BA screws; although those shown on the drawing and photos are cheese headed, hexagon heads would look much more attractive. Put gaskets made from thin, oiled, brown pa-



A modification to the front cylinder cover will allow the use of an O-ring packing.

A false cover is made to take an O-ring, the normal cover is made without packing. Both covers are fitted using the existing 10 BA screws.

per between the cylinder covers and the ends of the block.

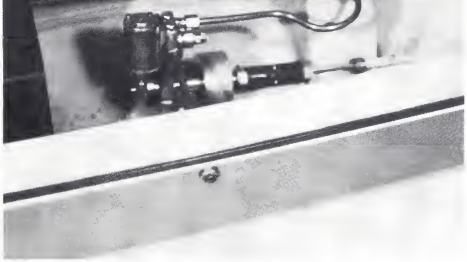
The piston assembly comprises piston, rod, and big-end or crankhead; obviously accuracy here depends on the threads in each of these components being truly concentric. The piston itself should be turned from oversize bar and the threaded hole and outside diameter formed at one setting; that is presuming you do not have a collet chuck that will allow final finishing of the piston to be carried out with it screwed on the piston rod.

The crankshaft and flywheel assembly is the final constructional work needed. You will notice that the throw is quoted as 5/16" "bare", this is because the crankdisc is only ¾" diameter and there is a risk of the 5 BA thread breaking through on the periphery of the disc. Do as I did, and make the crankdisc slightly larger in diameter and the problem is solved!

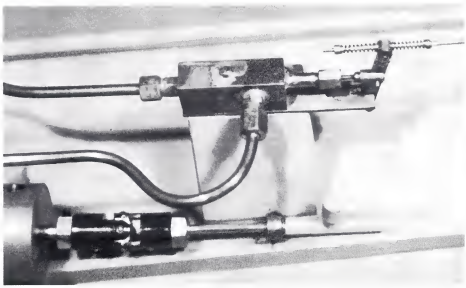
A word, at this point, about screw threads; the Anvil drawing specifies 5 BA and 2 BA in a number of places, these may, of course, be ⅛" x 40 tpi and 3/16" x 40 tpi respectively.

Now, this little engine will be quite greedy, steamwise. So the boiler needs to be up to the task.

Well, I hope Anvil will "strike" you as an interesting project, and that you'll have lots of fun building and running it. Finally, for beginners, may I mention that, looking at the engine from the front, i.e. the cylinder end, the direction of running will be clockwise with steam entering the left-hand steam-way on the frame upright, and vice versa.



This photo shows the exhaust port opening in the hull side.



A look at the throttling valve and linkage. The valve is a simple needle-valve arrangement. Note also the universal coupling and the in-board detail of the outer propeller shaft.

Anvil Materials List

Cylinder and Covers brass ¾" diam x 1¾" long
Base & Port Face brass 1" x ⅛" x 2¼" long
Standard brass ⅝" x ¼" x 2¼" long
Main Bearing brass ⅜" dia. x 1⅛" long
Piston brass ⅝" dia x ½" long
Crank-head brass ¼" square x ½" long
Flywheel bright mild steel 1¼" dia x ¾" long
Crank-disc bright mild steel ¾" dia x ¼" long
Crankshaft bright mild steel ⅜in" dia x 2" long
Piston rod, Trunnion, Crankpin bright mild steel ⅛" dia x 3" long
Gland brass ¼" A/F hexagonal ⅜" long
Also: 8 screws 10 BA x ¼" long
1 nut 5 BA
I washer 5 BA
1 wave spring,
1 grub screw 4 BA

Golden Arrow

LOA: 1420mm
Beam: 225mm
Draught: 70mm

Engine: ½" bore x ⅝" stroke double-acting oscillating.

Boiler: 75mm outside diameter by 150mm long. Working pressure: 241.3 kPa (35 psi)

Two-channel radio control: 1. Throttle. 2. Steering (Sanwa Dash or equivalent).

If you don't have the facilities or inclination to build an engine and/or boiler you might like to have a look at the range of engines/boilers offered by Classic Marine Steam. They also offer radio control equipment. See their ad in this issue.

The Bolton No.5 engine from E&J Winter may also be suitable.

For your marine timber requirements contact the Tiny Timber Yard they are sure to have what you need. See their ad in this issue... ed

Full-size plans of the hull and boiler will soon be available from AME Retail. The prices have not yet been set.

Shop Hints of Peter Dawes

5 Mill/Drill Column Extension Ring

This hint is a follow-on from a previous article [AME May-June 1995, issue 60, page 50] which showed a method of getting a few extra millimetres height under the work head on a Mill/Drill. After having to do the raising exercise a second time I decided it would be worthwhile to make a removable adjustable ring to act as a moveable "foot". It encircles the 100mm column and clamps up firmly by means of two cap screws. This meant I could avoid the fiddly G-clamp, and make the whole operation quick, very easy and safe.

There are two ways to make such a ring:

1. One is to obtain a piece of thick steel big enough to encircle the column with lugs so that when it is cut in half, the two halves can be bolted together to clamp it firmly.

2. The second way is to make it out of 10 x 19mm flat steel — for a 100mm diameter column. Heating and blacksmithing it into a ring around a former the same diameter as the column. Or it can be bent cold around a former slightly smaller in diameter if you have a very strong vice to hold it. I used a 100mm diameter steel wheel blank as the former. Start with a 1200mm length of bar in order to get leverage for the bend. A 5lb hammer also helps with the forming.

The first few centimetres or so usually defies bending so cut that straight bit off after the curve is started, then continue and finish the second end as best you can. If you want to machine the outside diameter you need to weld the ends together first and cut them apart again later but this is not essential. However, it is essential to turn the inside, so do this as described below.

To make the lugs cut four pieces of 19 x 10mm steel 16mm long. Clamp them together in pairs and drill through the centre of both sets for the tapping size of the screws you will be using. Open out the hole in *one* piece of each pair for the clearance diameter of the screw. Tap the other two pieces.

Grind a slight bevel on the two edges that will be welded to the ring so that they fit close. Bolt each pair together with a spacer approx 3mm thick in between. Weld one pair straddling the open ends of the ring and the second pair diametrically opposite. Weld them on firmly. You can also grind a bit of a flat on the ring itself to get a better fit if necessary.

If you did not weld the ends together before, then put a packing piece in the split side of the ring and clamp it up tight. Chuck the ring and turn the inside for a good fit on the column (-0 +10 thou) for a flexible ring and +3 thou for a rigid ring). Also turn a bevel on one inside edge to match the bevel on the bottom of the column into which the end of the rack fits. Cut the ring in half now and grind or cut the extra 1-2mm out from between the lugs so there is the necessary free play to clamp it tightly around the column. Fitting the two cap screws completes the ring.

For a smaller diameter column, such as 75mm or less, use 8mm or 6mm x 19 mm bar stock with lugs in proportion. The ring replaces the G-clamp, see the previous article for details of its use.

A Metric Thread Alternative

by Geoff Murdoch

Not so long ago I bought some 6mm diameter x 50mm long hex head bolts knowing full-well that in my workshop I had a 6mm tap to cut the required threads.

Once in the workshop, the job was marked out and the threads duly tapped. The mandatory testing of the threaded end of the bolt in the newly threaded hole was carried out to ensure that all was well. So far so good.

On fitting the bolts to the job it was discovered that the threaded end of the bolts was about three threads too short. Not so good - because I didn't have a 6mm die to cut the threads to the required length.

Thinking how I would get around the problem, I remembered that BA threads are metric. No — it's not a misprint!

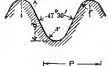
Some people are astounded when they discover that BA threads are indeed metric.

The largest thread in the BA series — 0BA — has a 1mm pitch and each successively smaller thread is 0.9 smaller in pitch. The depth of thread is 0.6mm of the pitch.

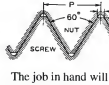
It turned out in my case, that tucked away in a bottom draw I had a 0BA die (6mm diameter and 1mm pitch) which allowed me to cut the extra threads and finish the job in hand.

OK! The purists may rightfully ask: "What about the difference in thread angles between BA and Metric threads?"

BA being 47.5 degrees and ISO Metric; 60 degrees.



The BA thread form.



The ISO metric thread form.

The job in hand will determine either the accuracy or strength required and therefore any allowable leeway.

In my case, the function (or end use) of the parts were not compromised and it allowed me to finish the task quickly and without needlessly spending extra money on a 6mm die.

Perhaps there are other threads that have a similar "compatible" alternative?

Cleaning the Leadscrew

by Ross Edmondson

One good way to get all the swarf and shavings out of your lead screw before screwcutting is to use an old pair of the good wife's nylon stockings!

Of course make sure she's not still in them and the fun part is getting them off!

Poking one end of the stocking around the lead screw, get hold of one end in each hand and with a see-sawing motion work your way along. You'll be amazed at how bright and shiny it comes up...

Hacksaw blades

by Ross Edmondson

What do you do with your blunt or broken hacksaw blades?

Before throwing them in the bin, they make good paint stirrers. Another use is to grind the teeth off them put them in the vice, wrap a piece of cloth around them and bend them over until they break. The short bits make good packing pieces under the lathe tools to get the "right height"

A Scale Dimension Calculator

by Tom Hulse

Faced with the daunting task of scaling down hundreds of dimensions from a full set of Tasmanian Government Railways K class Garratt drawings to build a 5 inch gauge version, I had to find a better way than pecking away at a calculator for days. My schooldays in the 'sixties were spent in a metric country so the need was to take a dimension, such as 2 feet 11 inches on a 2 foot prototype gauge drawing, and scale it down to millimetres for a 5 inch gauge loco. For good luck perhaps we could also scale it down to inches for those who prefer to work imperially, or who still have a perfectly good 0-4 inch Moore and Wright micrometer and don't see the need to spend more money on a metric version.

Do your tax, too

The answer was to use the accountants' friend, the computer spreadsheet. A large number of readers will no doubt mutter choice words at this point and flick over to the next article, but the figures show about 25% of households now possess a computer so I better continue. If the previous sentence makes you feel all left out of the now generation, there is still time to rush out and buy one.

The spreadsheet program now to be described was built in Microsoft® Excel® and before I go into a description it is assumed you are reasonably familiar with Excel, or at least prepared to learn. This is a simple spreadsheet application that should be easy to convert into Lotus 1-2-3® or some other brand spreadsheet. That you will have to do yourself, as all I have is Excel.

My thanks to AME editor Brian Carter for his helpful suggestions which broadened the scope of the calculator to include traction engine and marine scales.

The screen

The program has a single screen, and this is shown in the figure. Note the letters across the top (Columns) and numbers down the side (Rows). This serves as a reference for all the boxes you will write in. To use it for Rail, first type the model gauge in box B3 (Column B, Row 3) for feet and D3 for inches, and the prototype gauge similarly in boxes B4 and D4. Do not leave any boxes blank, at least leave a 0. Key *Enter* and the program works out and displays the scale in % (B7), 1:x (D7) and inches to the foot (E7). You do this once and don't have to touch it again as long as you as you are working on the same model. The screen displayed shows my use of it: 2 foot prototype (the North-East Dundas Tramway) and the scale gauge of 5 inches.

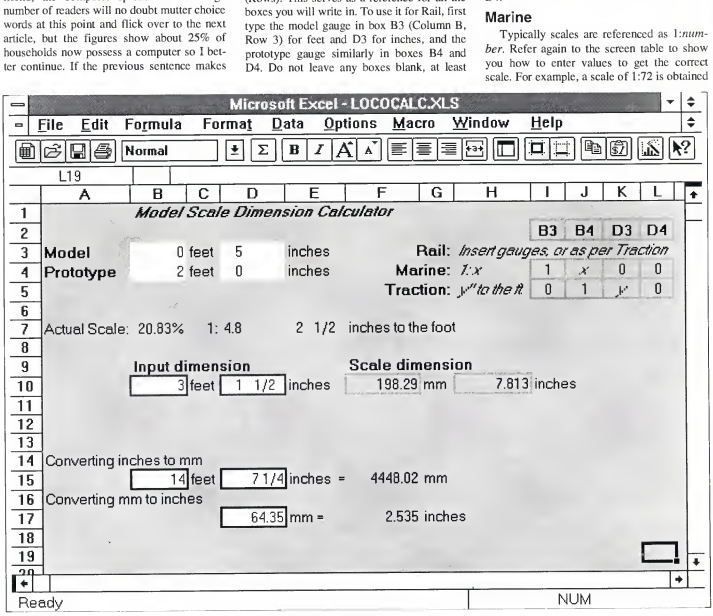
If you prefer a particular inches to the foot scale instead, use the method employed for traction engines.

Traction

Traction engines and some rail scales use inches to the foot. The screen table in columns I to L and rows 2 to 5 show you what to put in each box. For example, a scale of 1⅛ inches to the foot is obtained by putting 1 in the prototype feet box B4, 1⅛ in the model inches box D3, and 0 in the other two boxes B3 and D4.

Marine

Typically scales are referenced as 1:*number*. Refer again to the screen table to show you how to enter values to get the correct scale. For example, a scale of 1:72 is obtained



C (Column)	R (Row)	Type in the following: *(make sure formulas are exact)*	Format
B	1	***Model Scale Dimension Calculator***	9.5point Times, Bold, Italic
I	2	B3	9.5pt Times, Bld, Align centre
J	2	B4	9.5pt Times, Bld, Align centre
K	2	D3	9.5pt Times, Bld, Align centre
L	2	D4	9.5pt Times, Bld, Align centre
A	3	**Model**	9.5point Times, Bold
B	3	**(No text - entry box for feet)*	Format No., Number, 0
C	3	feet	9.5point Times
D	3	**(No text - entry box for inches)*	Format No., Fraction, #??/??
E	3	inches	9.5point Times
G	3	**Rail:**	9.5pt Times, Bold, align right
H	3	*Insert gauges, or as per Traction*	9.5point Times, Italic
A	4	**Prototype**	9.5point Times, Bold
B	4	**(No text - entry box for feet)*	Format No., Number, 0
C	4	feet	9.5point Times
D	4	**(No text - entry box for inches)*	Format No., Fraction, # ??/??
E	4	inches	9.5point Times
G	4	**Marine:**	9.5pt Times, Bold, align right
H	4	*1:x*	9.5point Times, Italic
I	4	1	9.5point Times, align centre
J	4	*x*	9.5pt Times, Ital., align centre
K	4	0	9.5point Times, align centre
L	4	0	9.5point Times, align centre
G	5	**Traction:**	9.5pt Times, Bold, align right
H	5	*y* to the ft.*	9.5point Times, Italic
I	5	0	9.5point Times, align centre
J	5	1	9.5point Times, align centre
K	5	*y*	9.5pt Times, Ital., align centre
L	5	0	9.5point Times, align centre
A	7	Actual Scale	9.5point Times
B	7	=(D3/12+B3)/(D4/12+B4)	Format Number, %, 0.00%
C	7	=":"	9.5point Times, align right
D	7	=ROUND(1/B7,1)	Align left
E	7	=(D3+B3*12)/(D4/12+B4)	Format No. Fraction #??/??
F	7	inches to the foot	9.5point Times
B	9	**Input dimension**	9.5point Times, Bold
F	9	**Scale dimension**	9.5point Times, Bold
B	10	**(No text - Entry box for feet)*	Format No, Number, 0
C	10	feet	9.5point Times
D	10	**(No text - Entry box for inches)*	Format No., Fraction, # ??/??
E	10	inches	9.5point Times
F	10	=ROUND((D10/12+B10)*304.572*B7,2)	Format general
G	10	mm	9.5point Times
H	10	=ROUND((D10/12+B10)*12*B7,3)	Format general
I	10	inches	9.5point Times
A	14	Converting inches to mm	9.5point Times
B	15	**(No text -Entry box for feet)*	Format No.,Number, 0
C	15	feet	9.5point Times
D	15	**(No text - Entry box for inches)*	Format No., Fraction, #?/?
E	15	inches =	9.5point Times
F	15	=ROUND(((B15*12)+D15)*25.381,2)	Format general
G	15	mm	9.5point Times
A	16	Converting mm to inches	9.5point Times
D	17	**(No text - Entry box for millimetres)*	Format general
E	17	mm =	9.5point Times
F	17	=ROUND(D17/25.381,3)	Format general
G	17	inches	9.5point Times

Column Widths							
A	11	B	6.71	C	3.71	D	7.86
E	7.29	F	9.14	G	3.86	H	9.43
I	3.86	J	3.86	K	3.86	L	3.86

by putting 72 in prototype feet box B4, 1 in model feet box B3, and 0 in the other two boxes D3 and D4.

Now for the frequent usage. Click the mouse cursor in box B10, enter in the prototype dimension in feet, move or tab the cursor to box D10, and enter inches and fractions of an inch in that box. Fractions are entered as numerator, backslash, denominator, with a space between the inch and the fraction. Thus One and eleven sixteenths is 1 11/16. If the dimension is under one foot, enter 0 in the feet box, and if an exact number of feet, enter 0 in the inch box.

And before your very eyes...

Now all you have to do is key *Enter*, and the dimensions you need fill the required boxes automatically. You get millimetres to two decimal places in one box, and thousandths of an inch in the other box. Take your pick. For the next dimension you don't have to erase the previous, the new entry will overwrite the last. The method has a minimum of keystrokes and reduces the chance of error. For each dimension the keystrokes are feet, *tab*, inches, and *enter*.

There is also an inches to millimetres and millimetres to inches calculator if it's needed.

To build the spreadsheet, refer to the attached table, which tells you what to enter as text or formula for each box referenced as *letter, number* where *letter* is column and *number* is row. To build the spreadsheet, click on the relevant box and type in the text, followed by *Enter*. The text with an = as the first letter is recognised by the program as a formula, and will not appear in the spreadsheet after you key *enter*, but keep in the background, supplying the required answers to fill that box. Save your work regularly; giving it a suitable filename such as LOCOCALC.XLS.

Format your screen to make it pleasant and easy to use. Select the complete screen with your mouse and turn it yellow (or some light colour) by selecting Format, Patterns and the solid for pattern and yellow for foreground. Then select each box you enter figures in (* in the table) and turn it back to white in a similar fashion. You could even put a say, red coloured border round these boxes and a green border around those that provide an answer. Although of course the colour does not show, the borders can be seen in the figure.

Format your text also to give emphasis - this formatting, using Format, Font is given in the table. Set the column widths also as per the second table.

Now that you have you have your measurements so much quicker, see you in the workshop.

A Chuck Back-stop for the Myford Lathe

by Ron Miles

Drawings for publication by Neil Graham

Sometimes when chucking, a job support is needed at the back to keep the work aligned while closing the chuck jaws. If you have had this problem then this simple accessory is for you.

The back-stop is formed by passing a close fitting bar down the lathe spindle (stop bar figure 2) and locking it in the desired position with the stop-bar lock (figure 1). The job is then held hard up against the stop bar and the chuck jaws tightened.

The dimensions are for the Myford Super Seven B. With suitable modification the principle may be adapted to other lathes.

Stop-bar lock

Figure 1. This is a collar that fits on the end of the lathe spindle, which on my lathe was 0.875" diameter.

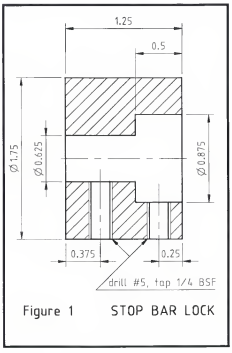


Figure 1 STOP BAR LOCK

Begin by chucking a piece of free-cutting mild steel 1.75" diameter. Drill and bore right through the 0.625" hole. Then widen the hole for 0.5" to 0.875" diameter. This should be a close sliding fit on the end of the lathe spindle. Face off both ends to the dimensions shown. The next step is to drill and tap the holes and fit the set-screws.

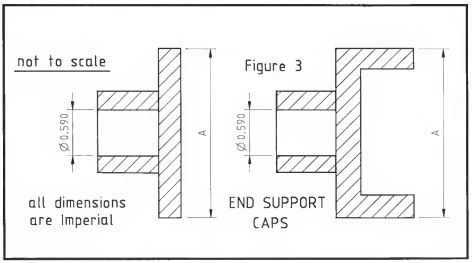
Purchase two Unbrako socket set screws no longer than ½" as you don't want the heads projecting when the spindle is revolving. The belt and change wheel guards cannot be closed when using the back stop.

Stop-bar

Figure 2. The Myford manual gives the spindle bore as 0.594". I found however that a 0.625" rod was a good sliding fit down to the back of the taper. You will need to check this dimension on your lathe. A good sliding fit is necessary to maintain the alignment. The stop-bar should be at least 16" long. I made mine with 4" protruding out of the locking collar.

You will need to reduce the diameter of the bar for 4" at the chuck end. Apparently the 0.594" dimension is to the bottom of the number two Morse taper only. Centre both ends of the bar and turn down to 0.590" between centres.

Figure 2 STOP BAR



Having done all this you can set it up for use. Place the stop-bar lock on the end of the lathe spindle and lock in position with the inner set-screw. Slide the stop-bar into the collar and down the spindle to the chuck jaws. It should slide easily without shake. You now have an adjustable back stop, which you can lock in any position with the outer set-screw.

End-Support Caps

Figure 3. These will turn the standard version into the deluxe model. These slide over the end of the stop-bar providing greater support for the job. They will need to be made to suit your particular chucks. The cup-type one is for when you need to drill holes in the job. The dimension A should be slightly less than the diameter of the job.

Simple Power Feed

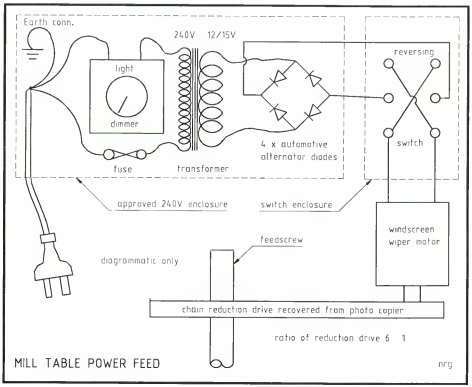
by Darryl Cleburne

Drawing for publication by Neil Graham

This is a simple, cheap and effective power feed for either a mill table or lathe feedscrew that I have developed.

The accompanying diagram is fairly self explanatory, however I will elaborate on the details:

- The transformer is a 240 volt to 15 volt step-down rated at 3-5 amps. A heavy duty model train power supply may be suitable.
- 24 volt, 500 watt household domestic light dimmer.
- The diodes are automotive power rectifier diodes from a car alternator rated at 40-60 amps, connected to give a full wave bridge rectifier. Most cars have six diodes, so you'll have a couple of spares.
- The motor is an old 12 volt automotive windscreen wiper motor.
- A fuse carrier and fuse is a necessary item to protect the hardware, 3 amps should be okay.
- The reduction is achieved by using the sprockets and chains from an old scrapped photo copier. I have found a reduction of approximately 6:1 is ideal to get the correct range of speeds.
- The reversing/isolation switch is available from Dick Smith or similar electronics components retailer. The switch is a centre off, double pole, double throw type, rated at 3 amps minimum.



The diagram shows the general idea, however, the actual layout of the power feed device would depend on the components you can source and the machine you wish to drive. The light dimmer is the speed regulator. It gives a very positive, accurate and fully adjustable feed.

N.B. We strongly recommend that those who are contemplating the above project, have an approved 240 volt enclosure provided and a licensed electrician wire in the 240 volt components for you... ed.

Small Socket Wrenches

by Bob Kimber

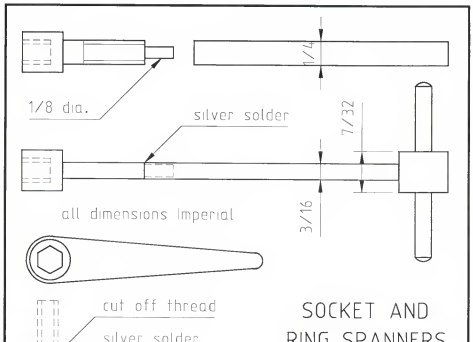
Re-drawn for publication by Neil Graham

Socket head screws form the basis of these, either in metric or imperial sizes. I prefer the 'T-handle' format, and have made a number of varying sizes and lengths.

Start by turning down the threaded end of the screw to fit nicely into a hole drilled in the end of the shaft material and silver solder them together. Then turn the outside of the whole works and cross drill the end for a handle about 3/32" diameter and about 1 1/2" long. I find handy lengths to be from 1 1/2" to 5" overall.

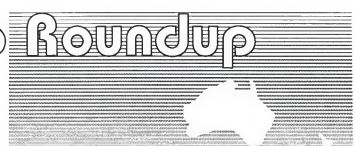
The same screws can be used to make small ring spanners by cutting off the screw heads and silver soldering them to narrow strips of steel in the manner shown.

Reprinted from MELSA Maryborough Newsletter... ed



Share your ideas with the world — send them in to AME!

Club Roundup



Castledare WA

Many individuals and organisations donate goods and services to assist in the ongoing success of the Castledare Miniature Railway. As a way of showing appreciation the committee decided to hold a Sponsor's Day in April, the intention being that this be an annual event. The day was a resounding success with most sponsors attending and enjoying train rides and a barbecue.

Another event which members found most satisfying was the donation to Princess Margaret Hospital for Children by CMR of a set of digital baby scales specially designed for very small or premature babies.

Refurbishment is the order of the day! A concerted effort by members has resulted in painting of loco shed doors and water towers, a start on the refurbishment of both Niana signal boxes and reglazing of ticket box windows. Passenger wagon bogies have received attention with some being replaced by new ones and the fire train has been fitted with special fixtures designed to produce different spray patterns for weed spraying and for damping down the track on high fire risk days.

Castledare Miniature Railway
Location : Rear of 100 Fern Road, Wilson
Public Running: 1st Sunday of each month

Invercargill NZ

The 1996 Great Little Train Show was a great success and membership application forms were in great demand giving club numbers a welcome boost. In an effort to gain more storage space, permission is being sought to extend the train shed as a tender for a surplus building did not succeed.

It was previously mentioned that the men came second in the last Southland Efficiency Trials but further details were not available. Six trophies were up for grabs. Sue Head won two of them including 1st Steam, Stacey Wilson took two including 2nd Steam, Rebecca Clark was the Best Junior and for the men Donald Ross won 1st Diesel. Can't be bad for the hobby!

Southland Society of Model Engineers Inc
Location : Surrey Park, Invercargill
Public Running: Unknown

Moorabbin Vic

Graham Plaskett (Ph. 03 9789 5093) was elected Secretary at the AGM while Ken Rofe remains as President. The March meeting was a bit different with Jim French driving into the club room with his full scale replica of a 1885 Benz 3 wheeler horseless carriage, the first petrol driven car. It features tiller steering and a 1000cc single cylinder engine develops one half horse power. The passenger pushes on the hills. The replica took two and a half years to build.

Do you have fox hunts in your club? At a recent Silvertops day one member driving a loco chased a fox out of the cutting behind the clubhouse. It shot off across the grounds, down the drive and up Rowans Road, somewhat startling a passing motorist.

Steam Locomotive Society of Victoria Inc.
Location : 128 Rowans Road, Moorabbin
Public Running: First Sunday of every month

Tauranga NZ

President Peter Jones, revealed in his report to the AGM that in the past year 16533 tickets were sold and the club loco clocked up 2962 kilometres. Currently members have 11 locomotives under construction. Working bees have achieved much with the additional loop and spur track, work on the steaming bays, etc and plans are progressing for the ground level track extension. Peter continues as President whilst Don Hamilton has taken over as Secretary.

Tauranga club are hosting the 1998 International Model Exposition in January 1998. The Expo will cater to all forms of model engineering and there will be displays, demos and trade stands. The venue is adjacent to the club track which caters for gauges from 2½" to 7¼". A team led by Les Moore already has arrangements well under way.

Tauranga Model Marine and Engineering Club
Location : Memorial Park, Tauranga
Public Running: Every Sunday

Maryborough Qld

The monthly MELSA Sundays in the Park are in full swing again. This popular attraction went through a bit of a lull when the brass band which provided the music and refreshments was unable to continue as a result of internal problems. Two other local bands have made themselves available and the new arrangements are most successful, with more variety now being on offer.

Some members have been kept busy improving storage capacity, streamlining coal crushing operations and extending the concreted passenger loading area at the station. The MELSA track continues to be popular with live steamers, out of town visitors usually with locos turning up to almost every running day this year. Maryborough celebrates its Sesquicentenary next year and the MELSA members are preparing for a busy year, with all the club's events appearing in the year long calendar of activities.

Model Engineers and Live Steamers Assoc., Maryborough Inc.
Location : Queens Park, Maryborough
Public Running: Last Sunday of month

Gisborne Vic

Recently the Gisborne District Steam and Engine Society were required to provide a copy of their aims to a government department to support an application they had lodged. Consequently the committee had to adopt some. The aims of the Society are:

- To encourage the preservation of our local heritage by collecting historical agricultural and other machinery for restoration and display in a museum complex
- To acquire and preserve historic 2ft gauge railway equipment
- To operate a 2ft gauge passenger carrying steam railway around the Gisborne Steam Park
- To construct and operate a 7¼" passenger carrying railway within the Gisborne Steam Park
- To provide regular operating and inspection days for the public and our members
- To hold regular public rallies (at least two) each year
- To develop the Gisborne Steam Park into a multi purpose area

Members have been active on the rally scene this year. At the Seymour Alternative Farming Expo the club's three day display included a 7¼" train giving rides, a draught horse demo and pony club rides. Some members took a Fowler road roller to the Echuca

Club Roundup contributions

AME is pleased to receive club newsletters for consideration in this section. Newsletters are often a good source of articles, which we appreciate all the more, but most of all they help us keep in touch.

It is often difficult to decide what to publish and what to leave out. and the task of selecting material for a wider audience takes a lot of time. Also, there is always the risk that AME will publish something that the club considers sensitive. Please help by sending a "press release" page with your newsletter, or highlight the items you think we could use. We'll give first preference to clubs that help us out this way.

bmc

Steam, Horse and Vintage Rally where it was in steam for both days. Their own 9th Rally was a success. The weather was great, the events well attended and the bank balance contented. A total of 43 tractors contested the tractor pull, the best yet.

The Gisborne District Steam and Engine Society Inc.

Location: Gisborne Steam Park, Webb Cres., New Gisborne

Public Running: 1st Sunday of month

Wollongong NSW

Illawarra members faired well at the AALS Convention. Ross Bishop-Wear was awarded the Bolton Trophy for his finely detailed 0-6-2 Fowler Locomotive *Toneya* and Barry Glover was awarded the Southern Federation Trophy for "Club Man of the Year". Well Done!

The track gang continues to make progress with the lifting, re-sleepering and ballasting of the second section of track from the boom gate, west along the car park and then down behind South Box to the culvert. The track has been raised about 100mm and graded evenly to give a steady climb from the culvert to the top of Top Loop. The concrete pad for the elevated coal bin is in place and compressed air is at hand into the steaming bays.

Illawarra Live Steamers Co-Op Ltd

Location: Stuart Park, Westside Squires Way, North Wollongong

Public Running: 4th Sunday of month

Eltham Vic

The DVR 30 Hour Rail-a-thon came and went and is now available on Video. Traffic was down about 50% on last year which was disappointing, but the Grand Prix and Moomba were on the same weekend. Members did however turn the event into a good social gathering with a great barbeque.

Repairs to the turntable developed into a major project when it was discovered corrosion in the pit was the cause of leaking hydraulics. The ram was removed from the ground, a circular concrete pit constructed to contain the ram, oil tank, oil pump and drainage pump. The old pump house was removed and replaced with a control box with Up/Down controls for the turntable ram.

Diamond Valley Railway Inc.

Location: Eltham Lower Park, Main Road, Eltham

Public Running: Every Sunday

San Francisco USA

The return to warmer weather means the potluck Sunday barbeques are in full swing again. They are held on the Sundays following the Friday meetings. Also railroad operating sessions are run by the Thursday Fun Gang whose motto seems to be "Fun, not work is the name of the game"

The Spring Meet saw a good turnout with eighty diners at the catered BBQ on Saturday.

Golden Gate Live Steamers Inc.

Location: Tilden Park, Loma Cantadas and Grizzly Peak Blvd., Berkeley, California.

Narara NSW

The massive works undertaking is progressing well. The turntable down by the swamp is basically operational, requiring only some track to reach it! There are to be four roads off it. The new drainage arrangements were tested during and after a torrential storm and passed with flying colours. Work on the new clubhouse is on target to reach lock-up stage by the end of August.

The SRA 80 class club loco has been sprayed after a substantial rebuild and is now fitted with clear instructions regarding battery hook up, and comes with a request to take it easy on curves and points.

Central Coast Steam Model Co-Op Ltd

Location: Lot 10 Showground Road, Narara

Public running: 1st Saturday of month

Bribie Island Qld

Work continues on improving the MELSA Bribie track and facilities, By the time this arcticle is printed the turntable bays should have been extended and a second on/off track to the turntable should be finished. The one-in-forty gradiant around the back of the section of the track will have been altered to a more manageable one-in-eighty, thus enabling smaller, locos to get bigger loads over the summit. Future improvements are likely to include carriage and wagon sheds and a balcony around the QR guards van which is our canteen/store room.

Once again our very popular two-day run on Sat 19 and Sun 20 October 1996 will take place. Any visiting clubs and locos of 5"and 7¼" gauges will be most welcome. Ring (07)32831591 for further information.

For any southern visitor coming to Queensland for a holiday please try and bring your loco with you as you will always be made most welcome.

MELSA Bribie Island Qld

Location: Toorbul St., Bongaree

Public running: 3rd Sunday of month

Club query

The **Logan Model Engineering Society** in Queensland sent a Newsletter to the Steam Locomotive Society of Victoria... Can someone from the Logan Model engineers write to AME and tell us about the club?

Coming Events

7, 8 September
14th Birthday run — Narara NSW

The Central Coast Steam Model Co-op Ltd invite everyone to share in their birthday party! Saturday, 11am - 4pm, running for the general public. Saturday evening, free barbeque for AALS visitors. Sunday, private running for AALS affiliated clubs. Morning/Afternoon teas and lunch, both days, provided free. Plenty of room for caravans or tents. Contact: Tom Winterbourne (043) 25 4838 for more details. (5"and 7¼"g ground level track.)

14 September
Interclub run — Prospect SA

The Adelaide Miniature Steam Railway Society at Regency Rd (off Maud St.) Prospect, welcome local and interstate model engineers to a great day of railway operations. Contact the Secretary, John Wakefield, (08) 362 3269 for further details. (5" gauge ground level track only.)

28, 29 September
Canberra Invitation Run

Come to Canberra for steam and flowers during the Floriade! Contact: Peter Hately (06) 254 7229. (2½" and 3½"g. elevated, 5"and 7¼"g. ground level track.)

5, 6 October
3rd Model Engineering Exhibition

Monash University, Melbourne. Join the fun and spread the word about our great hobby to an appreciative audience at this year's exhibition.

Exhibitors Wanted Contact: Robert Jones (03) 9801 6048.

11, 12, 13 October
Annual Steam Festival — Hornsby Model Engineers

Enjoy a relaxing weekend of steaming in bushland at Galston, just on the north-western edge of Sydney. Large display of members' work plus operational stationary engines. (3½"g and 5"g ground level track)

19,20 October
8th Miniature Traction Engine Rally

Inverell Pioneer Village, Inverell, NSW. Contact: Gordon Blake (067) 22 4272. Don't miss out on this great weekend!

19,20 October
Two-day Run at MELSA Bribie Island

Any visiting clubs and locos of 5"and 7¼" gauges will be most welcome. As usual camping on-site is available and a BBQ and night run on the saturday night — all other facilities available all weekend. Ring (07) 3283 1591 for further information.

28 to 31 March 1997
AALS Convention, Cobden, Vic.

Organizing Sec. Alan Hart

8 to 12 January 1998
International Model Engineering Expo, Tauranga NZ

Model exhibition, hobby displays,working demos, road vehicles, railways 2½"g, 3½"g, 5"g and 7¼"g.

Contact **EXPO 98** Secretary, 326A Devonport Road, Tauranga NZ.

Repairs to locomotive boilers on the Victorian Railways

Water Space Stays

by Doug Baxter

Drawings for publication by Brian Carter

Since their acceptance into regular service, the most common repair to locomotive boilers has been the removal and renewal of water space stays.

Testing stays

The Victorian Authority on the service of boilers was the Rolling Stock Book of Instructions. This clearly stated that at the 3000 mile 'A B' examination of the equipment, all stays were to be hammer tested by a competent boilermaker. This called for a very particular form of competence in which the boilermaker, using a favourite hammer, could detect a faulty stay by recognition of the sound resulting from a hit to the item. Attention had to be paid to the construction of the boiler, as stays close to the brackets, side irons and edges gave off a different sound to more isolated ones. While carrying out the test for stays, the boilermaker was also required to inspect for bulged firebox plates, cracks, corrosion and any other visible damage.

Broken stays

In addition to these tasks, the Book of Instructions, Rule No 118 stated: "When a broken stay is detected in a firebox, the stay must be renewed within six days. No boiler must be allowed to remain in service when two adjacent stays are broken in the firebox or the combustion chamber, nor when three or more are broken in an area of four feet diameter, nor when five or more are broken in the whole firebox, including the combustion chamber."

The boilermaker organised his work according to whether the boiler had a copper or steel firebox.

Copper firebox stays

In the case of a copper firebox, the most likely locations for failed stays were:

a) where the most movement occurred at the top corners adjacent to the firebox tube plate and firehole plate and,

b) where the hammering effect of the blow down valve closures worked the area of the hot spot just below the brick arch.

When the faulty stay or stays were located, it was necessary to remove a section of cladding to expose the stay at the outside of the firebox. This had to be carried out very accurately, and as it was almost impossible to use a measuring device, the area was marked by counting down from the top row of stays and in from the front row. The procedure for rectification was then as follows:

1. Remove the head which was formed by the rotary gun at assembly. This was known as the "bat" and was removed with a sharp flat chisel.

2. Drill out the stay from the shell plate using a drill just smaller in diameter than the root diameter of the stay thread. On most stays which had not previously been removed, this required the drilling of a 57/64" hole, the root diameter of 5/8" Whitworth thread. Prior to drilling, preparatory work was required to locate the drill centrally in the stay and to firmly locate the pneumatic drilling machine so that the power feed could be correctly applied. A common problem encountered when doing this work was the drill running off from centre after commencing. This was usually rectified by the tradesman cutting a guide path for the drill back to the centre with a round nosed chisel. See figure 1. Drilling was ceased when sufficient clearance had been achieved for the stay to be clear of the shell.

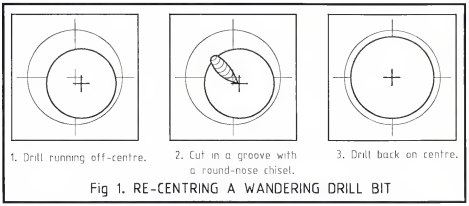


Fig 1. RE-CENTRING A WANDERING DRILL BIT

3. Remove the tailings of the thread remaining in the just drilled hole. All tradesmen had a special gouge which they used to allow this threaded tailing to be removed from the shell.

4. If the stay was not broken, but only fractured, repeat steps 1, 2 and 3 on the other end.

5. Remove the stay and any thread residue through a washout plug hole. It was normal for these parts to be displayed to a supervisor as evidence of the proper removal.

6. Clean up the thread with a tap. If the thread was damaged while drilling, the next larger size tap (plus 1/32") was used, thereby changing the size of the replacement stay.

7. Select a replacement stay. These were available in various lengths and diameters. They were supplied with full length threads, were undercut at one end and the other end formed with a square head to accept a spanner. See figure 2.

8. Replace the stay. This was inserted from the fire side of the shell to allow for the eventual removal of the square.

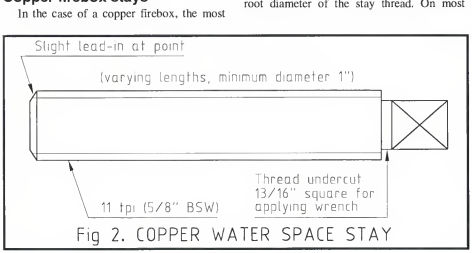


Fig 2. COPPER WATER SPACE STAY

9. Close the head. Allowing the correct protrusion for head closing, the head was closed to the plate by hand riveting, an assistant being required to hold up the dolly.

On some rare cases, it was found that the stay had failed in a position where it was inaccessible behind the frame. Special techniques, using "bullnose stays" were required to replace these. See figure 3. Each of these bullnose stays was individually machined and tapered to achieve a steam tight joint at the inaccessible end. The art of machining these stays was specialised and the skill disappeared during the 1950s. This led to the design of the J class locomotive boilers which had the complete sides of the firebox clear of the frame.

Steel firebox stays

The case of steel fireboxes was treated slightly differently and as follows:

1. Locate the removal drill in the telltale hole as the centre.

2. Drill until the drill flutes are level with the plate and check for accurate centring of drill and cut off the Bat. Continue with drilling in similar fashion to that outlined for the copper box.

3. Install a new stay. Application of a new stay was achieved using the same technique as was used when the boiler was built. The only difference to note was that the outer end could not be worked with the rotary gun, so hand riveting was required, the end then being pegged-down and whipped-in. A pegging-down tool was usually a drift of ⅝" diameter and 4" long. A whipping-in tool was made from chisel steel and was also about 4" long. See figure 4.

With broken or fractured flexible steel stays, it was only necessary to drill the fire side. This was because the removal of the outside cap allowed the broken stay to come down through the sleeve.

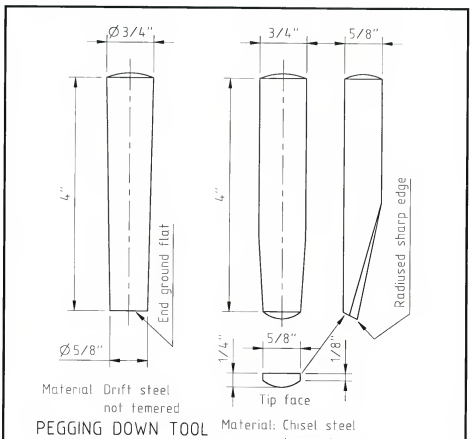


Fig 4

4. Install a new flexible stay. Application of a new flexible steel stay was also achieved using the methods used when the boiler was built. The joint was sealed on the fire side with arc welding.

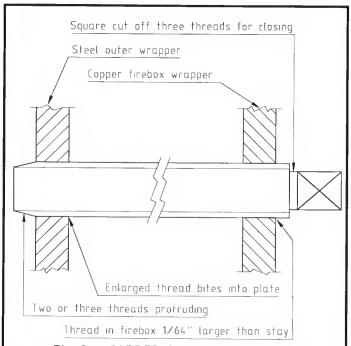


Fig 3. COPPER BULL NOSE STAY

5. Where access was poor, bullnose stays were applied as in the copper example except that the joint was sealed at the firebox with arc welding.

The regulation strictly followed at Newport was to liberally coat all threads with a mixture of graphite and engine oil to allow ease of later removal. Generally it was agreed that this procedure was not followed on boilers of locomotives imported from overseas with the result that the caps and sleeves were rusted together and successful removal was almost impossible. An attempt to free the joint had to be made by heating the sleeve with an oxy-acetylene flame and applying a sharp heavy blow to the spanner or wrench attached to the square. Often this would only strip the thread and the sleeve would then have to be replaced.

After completion, the work was examined by a Boiler Inspector. On sounding the flexible stays, it was often noted that a different sound came from the replacement stay because it was not at quite the same tension as the original. This would normally be accepted by the inspector when he noted that the sealing weld had been applied vertically on site as against the downhand weld which was usual when the assembly was done at build.

Experience pays

Towards the end of the steam era, there were experienced boilermakers who could remove the section of a flexible stay using the flame only, commencing burning at the telltale hole. Clean up could be completed merely with the gouging tool. Some experts could even drop a rigid stay from each side of the plate using this method. Nevertheless, inexperienced operators were encouraged to use the drill, as thread damage resulted in the otherwise unnecessary replacement with larger diameter stays. The maximum stay size was 1 3/16". If a larger thread was required, the hole was bushed.

Product Reviews

Locomotive Cyclopedia of American Practice

First-hand knowledge of steam engineering is fast disappearing. The average model engineer can find it quite difficult to acquire knowledge of the component parts of a loco. There are many good books that describe particular aspects of a loco class's design, but it's very difficult to obtain a wide-ranging coverage of everything in locomotives.

That's where this marvellous book comes in.

When steam reigned in the United States, the bible of locomotive design and engineering was the *Locomotive Cyclopedia of American Practice* published for the Mechanical Division, of the American Railway Association. It had an example of everything that ever got oily on a railroad. First published in 1905, the publication grew from an illustrated dictionary to a highly detailed, well organized and indexed cyclopedia from 1922 onwards. By the ninth edition in 1930, it was almost 1500 pages long.

Now and again you can obtain an original *Cyclopedia* at a second-hand bookshop, but after several years of trying I despaired of ever getting hold of one. Then a friend told me a few months ago that a reprint of the 1930 edition was available for less than the price of a second-hand copy. I ordered one. I haven't regretted buying it.

The 1930 edition was a good choice to reproduce, because there had been spectacular developments in American locomotive design during the previous five years. Importantly for us, these advances greatly affected Australian and New Zealand locomotive design during the late 1920s and the 1930s. The office of every CME with an interest in going beyond British practice would have had a cherished copy of the *Cyclopedia*. You can tell the American influence on designs by studying Australian and New Zealand locos from then till the end of steam things like frame and boiler design, and US-sourced components like mechanical stokers, power reverse gear, injectors, generators, rocking bars, drop grates, hopper ash-pans, arch tubes in the firebox and self-cleaning smoke-boxes.

I've become used to settling down into a good armchair to read this book. There are two reasons: I never want to put it down, and it's heavy — four kilograms!

Such is the quantity of the information in the *Cyclopedia* that it's hard to know where to begin describing it. It is copiously illustrated with fine line diagrams and/or photos, and the text is well written. First up is a table of contents by sections:

- steam locomotives
- boilers
- boilers: water supply
- boilers: fuel and combustion
- cabs; fittings; boiler mountings
- cylinders and drive gear
- frames and running gear
- lubrication; roller bearings
- tenders
- couplers and draft gear
- brakes and brake gear
- electric locomotives
- motor locomotives and cars [i.e., early petrol, diesel and diesel-electric locos]
- shops and engine terminals
- locomotive inspection and tests; safety appliances
- locomotive materials
- industrial locomotives
- foreign steam locomotives [including Australia and New Zealand]

This is followed by a 400-item alphabetical index to locomotive parts and a 90-page dictionary of terms. Next is a comprehensive coverage of loco development and representative steam locos — complete with photos and general arrangement drawings, from 0-6-0 progressively up to 2-10-4 and 2-10-10-2 types. Many different designs of boilers, with drawings down to the smallest parts, come after that. Then superheaters, throttles, injectors, check valves, blow-off valves ditto. Cylinders, steam chests, drain cocks, valve gear (Walschaert, Baker, Stephenson, Young, three-cylinder) and rods of all sizes are also covered. Next ...

As space is limited, there comes the time when I have to ask "Do you get the idea?" This is a book of extraordinary coverage and detail. As a browsing book or reference source, in a word: it's wonderful.

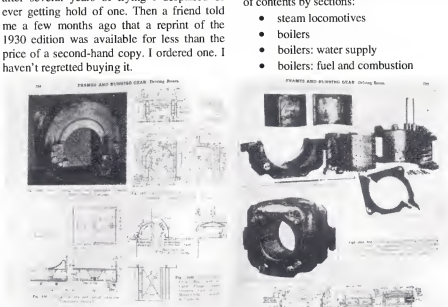
I got my copy from the UK-based Camden Miniature Steam Services, who advertise in AME. The total cost including postage was A$114.00 (£57.00). I had the option of paying about $20 for surface postage or $36 for air speed delivery, and I decided to go for the latter to minimize the chance of loss or damage. Less than three weeks after faxing the order, I took delivery of a cleverly cushioned cardboard box, a bit battered on the corners but very effective — the book was perfect inside.

When writing this review I contacted Stephen Larcombe of Plough Book Sales in Victoria, who also advertises in AME. Stephen said he gets books in from Camden, so if you want to order closer to home and respond soon after this issue comes out, he may order a few in.

Locomotive Cyclopedia of American Practice, ninth edition 1930 (reprint), 1440 pages, published by Newton K. Gregg, Novato, California, 1985. Availability: in text. Price: about $78 plus postage.

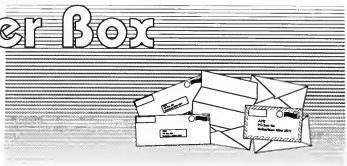
PS: Leave this review near someone who knows your idiosyncratic taste in books but never knows which one to get — under the pillow is a good spot. It will be hard for her to keep the *Cyclopedia* hidden till Christmas!

Clive Huggan



A tiny sample of the Cyclopedia's wealth of detailed information available to the model engineer.

Letter Box



A friendly hobby!

Sir,

The short item in Comment (issue 66) — *Model Engineering, an enjoyable hobby* — I think sums up the feelings of all model and miniature railway enthusiasts. One only has to think of the friendly atmosphere prevailing at any convention or a club's all-comers day to realize this. Model engineers are always ready to explain how they built a loco or engine and what problems came up and how they overcame them.

I think it is right to say there is a feeling of achievement among model engineers which you do not encounter in other organizations.

I took a relative as a visitor to the last AALS Convention. He is not in our hobby but a few days later I heard him telling another friend how he could walk right up to a model to look closely at it and he would soon be in conversation with the owner or any other person who might be there and you could also be sure of a reply like "sure jump on!" when requesting a ride with somebody.

I have a pin-on badge, made available by my club, with my name on it. This is a great help when talking to other visitors at a meeting to address them by name and be addressed by name, which I think creates a friendly atmosphere.

Jack Tatum
Victoria

The Steam Chest pump

Sir,

Thank you so much for your great articles in *Australian Model Engineering* once again. In answer to Dave Harper's request of "What kind of pump is hidden inside the massive casing?" in Steam Chest, May-June 1996 issue, the following is usually found.

Because large boilers i.e. marine/power station types, run at high steam pressures, the pumps to supply feed-water are usually multi-stage centrifugal, turbine drives as shown in the photo. Looking at the casing casting I would guess it is a 5- or 6-stage pump whereby the inlet/suction part is at the bottom centre as shown and the outlet probably on the other side at the left-hand end. The feed-water is drawn in by the first stage then pressurized and exhausted through internal porting into the second stage, is pressurized still further, and then on to the other stages in succession. Unlike positive displacement pumps (piston pumps), which can deliver relatively high pressures in a single stage/stroke, centrifugal pumps need several stages to achieve this — but in turn they can deliver high volumes of water in relation to the size of pump.

I hope this info is what you need. Keep up the good work!

Roger Jowitt
Western Australia

Letterbox Contributions

Contributions of letters by mail to: PO Box 136, Robertson, NSW, 2577 or fax to: (02) 9646 1362 are very welcome.

As far as possible, AME is an open forum for all members of our hobby. Therefore, all expressions of fact or opinion — as long as they are not libellous — will be considered for publication.

Please **type or clearly print** your letters, as script is often difficult for the typist to interpret.

The Letterbox is a popular medium of expression, so space is limited. Therefore, letters of 400 words or less will have a better chance of being published.

bmc

Sand-casting

Sir,

I have noted that the articles on *Sand Cast Metal Founding* that appeared in issues 62 and 63 have not been continued.

The subject of casting interests me greatly and I am wondering when this series will appear again.

My interest is mainly in the area of steam, and I enjoy Dave Harper's articles. I hope to build a steam engine some time soon and a traditional style steam launch, so any related articles would be very helpful and interesting. I would like some technical information related to boiler size and steam engine HP in the range suitable for an 18 - 20 foot launch.

John Vincent
Tasmania

John, a sand-casting article was in our July-August issue (issue 67) and another episode is in preparation for a future issue. Perhaps you should contact the Cleveland Steam Engine Company about the launch. See their ad in this issue... ed.

An open letter to our New Zealand readers

As I mentioned in News Desk and in a letter to all New Zealand clubs early in 1995, we decided to distribute AME through Gordon and Gotch (NZ) as a trial for twelve months. If the response covered the extra costs, we would continue. If not, then we would revert to subscription-only sales. Unfortunately, we can't get AME to New Zealand free: there are extra printing, transport and distribution costs. It was an effort to keep the cover price down to a bare minimum.

Of 500 copies of each issue currently sent to New Zealand bookstores ("newsagents" in Aussie), only about 150 are being sold. Many of them are shared around groups — and while that may be a wonderful example of friendly co-operation, it doesn't help to recover costs or encourage New Zealand advertisers!

We sincerely thank all those readers who have supported AME by purchasing the magazine through retail outlets. However, the general response from New Zealand sales has been disappointing. As predicted in the July-August issue, this will be the last issue available through New Zealand bookstores for the time being, as we are unable to maintain the loss.

As a benefit to our loyal New Zealand subscribers, we had managed to keep the New Zealand subscription price at the same level for six years! Our production costs and postage has risen yearly. Unfortunately, we can't absorb the increased costs any longer and we will have to increase the NZ annual subscription to A$40 from the November-December 1996 issue.

If you aren't already a subscriber, will you support our efforts by buying AME and giving it a serious evaluation?

For your convenience, a subscription form can be found on page 51.

Brian Carter

News Desk

compiled by Brian Carter

This issue sees the last of the 422 class diesel series. Judging by the large number being built or proposed it seems to have been appreciated .

A few good projects are coming up to keep you busy in the workshop!

We can always use good workshop articles so don't hesitate to contact us if you think you would like to have a go at an article. We are happy to offer all the support you need — it's your ideas and opinions we're after!

AME in NZ

Please read my letter at the foot of page 49.

AME in Oz

Our Australian readers shouldn't worry — the sales figures are good. We intend to increase the number of issues in the Australian distribution network because there is a shortage in some areas.

Our subscription base is also good. Besides our loyal local supporters, we are gradually becoming known on the world stage.

With the subscription mail-out of our July-August issue, a special pre-release price offer on the new 59 class book was included. This was very well supported — we had to order more books to keep up!

Because of the enthusiastic response, we may include other special offers from time to time as a bonus for our subscribers.

Trade and commercial

Myford lathes and spare parts are now distributed by **Myford Machine Tools Australia**, 6/16 Kenworth Place, Brendale, Qld, 4500. Phone (07) 3889 6191. Fax (07) 3821 6146. See the Myfor ad on page 53. Peter Uscinski, the Myford agent for many years, has wound down his business activities to concentrate on his marine steam engines. Peter is now trading as the **Cleveland Steam Engine Company**, 3 Voyagers Court, Cleveland, Qld, 4163. Phone/Fax (07) 3821 6146. See the ad on page 7.

The **Tiny Timber Yard** have a wide range of timber sections available from 10mm square down to 2mm square in lengths of 300, 600 and 900mm. You can choose from ten timber species! They can also satisfy special orders to your requirements. The timber sections are ideal for scale rolling stock or marine applications. See their ad on page 9.

Hare and Forbes machinery merchants have some interesting goodies on offer this issue for AME readers. Check out their ad on page 10.

1997 Calendars

AME Retail has just received the 1997 Calendars. A usual there is a *Steam era* version and a *Diesel era* version. Each calendar is 294 x 220mm with large easy-to-read date blocks with school and public holidays clearly shown. Price: $12.95 ea or $23 for two.

Readers' views

I received a couple of interesting letters since the previous issue of AME.

A reader is having trouble with the "Do Not Fold or Bend" label on the envelope. His local post office is making him pick up the magazine at the post office. Originally we had a flood of letters requesting the instruction "not to fold" on the envelope because the issues were being damaged as they were put in the letterbox. While we sympathize with the dilemma, it would be impossible for us to sort out envelopes in "fold" or "no fold" groups for individual readers.

If you regularly receive magazines in the post it might be a good idea to have a letter box large enough to accept them without folding. Even that doesn't always work — I made a letterbox with a slot big enough to take a large postpak containing 10 magazines. Sometimes I still have to go to the post office to collect articles that would have easily fitted through the slot!

The same reader also suggested we switch to plastic covers. We had thought about this, but we felt there is enough plastic in the world without adding more. Our envelopes are recyclable — and even better, they make great gasket material for steam engines!

The other letter suggested we drop trains from the magazine and concentrate on stationary steam engines alone. AME would be a magazine of four pages, going by the current flow of information in that area! We find that the current mix is working well — and many ideas in one area are transferable to another. This ensures a healthy basis for all model engineers to grow together, rather than be segregated. For example, the *Golden Arrow* boat article in this issue has a delightful steam engine construction component. This would have been lost with segregation.

We all have our "pet" focus, but let's continue to enjoy each other's talents and share our hobby!

Evandale poster

The Evandale Light Railway and Steam Society have produced a limited edition (500) print as a fund raiser. They are sequentially numbered and signed by the artist. The print — reproduced in miniature on the left — features pencil sketches of nine early Tasmanian locomotives on stout cartridge paper measuring 560mm x 450mm. They are available for $20 posted within Australia from: The Evandale Light Railway and Steam Society, 35 Collins St. Evandale, Tasmania, 7212.

Classifieds

Bound Volumes of the Model Engineer For Sale

- Vols. 143, 144 (parts 1 and 2); reprint editions Vols 1-12, 68, 84 and 100. Most in excellent condition $10 each, $95 the lot.
  Ph Michelle (07) 3366 3153

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- Ernest Winter design, quality engine. Fully detailed, copper boiler, built to AMBSC Code, inspected & tested by licensed boiler inspector. On display 8th Miniature Traction Engine Rally, Pioneer Village Inverell 19-20 October Price $25,000. Enquiries Tony Hills (067) 22 4460

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- Only one entry per issue.

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